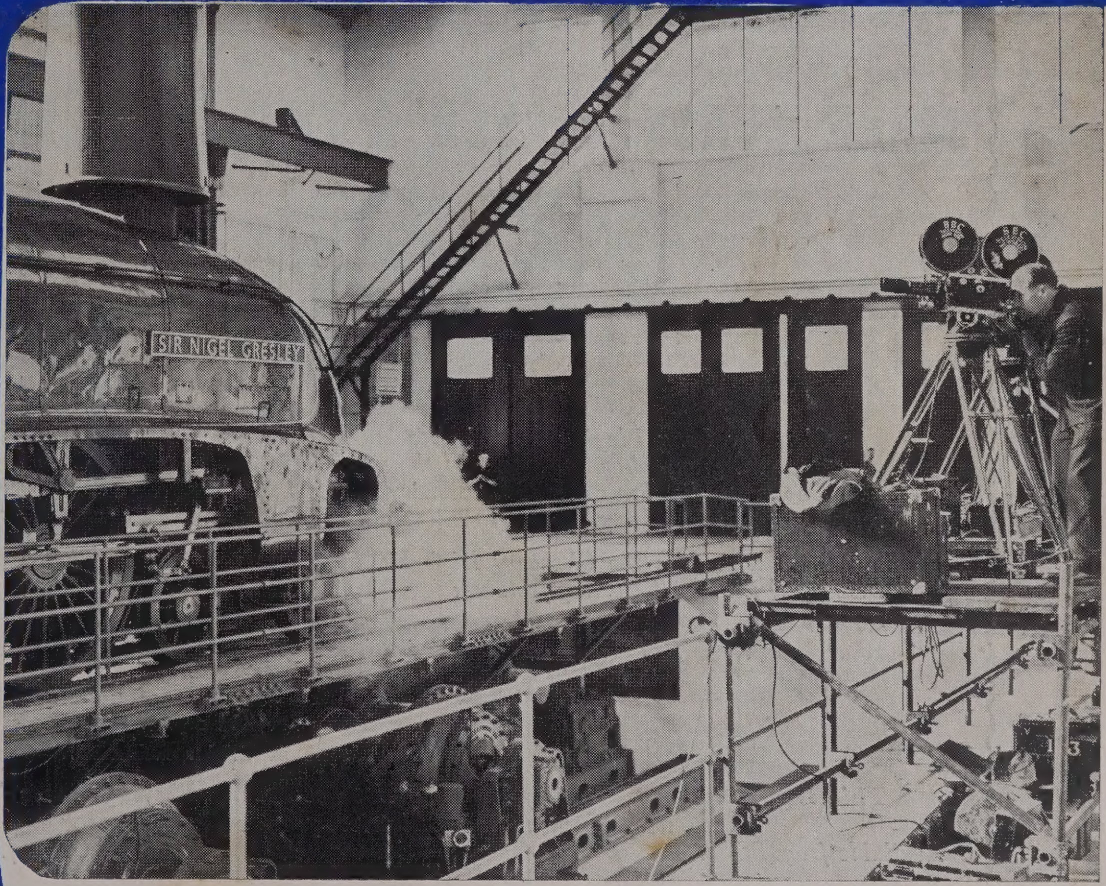
RADIO and ELECTRONICS

ELECTRICITY — COMMUNICATIONS — SERVICE — SOUND



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OUR COVER

Depicts a B.B.C. cameraman taking a shot for a TV film about British Railways. The engine is on a special test stand where its wheels can go at full speed without the engine itself moving.

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Fuller Use of Radio Communication

THERE ARE THOSE to whom the above title will undoubtedly mean much more difficult work. We refer to the unfortunate persons responsible for trying to squeeze an ever-growing number of channel requirements into an always limited slice of the radio spectrum. Be that as it may, radio communication is a tool whose use is by no means fully exploited. There are innumerable applications of the art which today remain unfulfilled for the very reason that ether space is at such a premium, that legislative restriction of the use of radio is essential. Such restriction is the only way by which chaos is prevented, for if anyone were allowed to operate a radio station for any purpose, on any frequency, world-wide interference would be such that no worth-while service would be obtainable by anyone.

It is fortunate, however, that many applications of radio which would be of inestimable value to many enterprises, require only a short working range. An admirable example of this is the use of radio by taxis, fire services, ambulances, and the like, and for such uses the very-high frequencies have come into their own, mostly because of limited range, and non-propagation by the ionosphere, ensure that long-distance interference is not ordinarily possible. However, these applications hardly scratch the surface of the vast possibilities of V.H.F. and U.H.F. communication. There is not space here to go into the question in any detail, but it is sufficient to note that at the present time a great many applications for licences to operate private communications have to be turned down by the authorities, on account of the existing regulations.

This does not mean that things will always be so. As techniques improve, it will be possible to use frequencies that are at present too high for inexpensive and reliable equipment to be built that would be suitable for use by non-skilled people. There are vast numbers of communication channels available at frequencies above, say 400 mc/sec., if only they could be used. If equipment were available, there is no reason why private operation could not be allowed, subject to type approval of equipment, as is the case with the so-called "citizens' band" in the United States. Gear like this, eliminating the need for skilled operators, and on frequencies high enough to prevent long-range interference between stations on the same frequency could literally revolutionize the radio industry overnight. At present, two things prevent the use of such equipment. First, there are no regulations permitting radio operation of this nature. This need not be an insuperable difficulty, however, because other countries already have such regulations, and similar ones could easily be framed to suit New Zealand conditions. Secondly, and more important, there is the difficulty of designing and producing equipment for V.H.F. and U.H.F., that would have the required performance at the same time at a price that would make it a commercial proposition. While it is true that the last fifteen years have seen great strides in the development of valves and other components suitable for the kind of frequency we are discussng, there are many things needed on the purely technical side before it will become easy and commonplace to design communications equipment for frequencies above 400 mc/sec. Here are a few of them:

(1) Transmitting pentodes which will work, without neutralization, and with high efficiency above 400 mc/sec.

(2) Cheap and easy methods of fabricating the special tuning elements needed for these frequencies, *e.g.*, co-axial lines, "butterflies," cylinder circuits, etc.

(3) A much simpler method than the present standard one for automatically controlling the frequency of oscillators working at frequencies higher than 100 mc/sec.

(4) Methods of obtaining crystal-controlled oscillations at very much higher frequencies than those at which direct crystal control is possible at present.

(5) Methods of making such things as disc-seal triodes and velocity-modulation amplifier valves as cheap as conventional valves.

(6) The development of low-drain battery-operated valves which will work at frequencies up to 2000 mc/sec. For example, we do not know of any battery-type disc-seal valves, or even whether it is possible to make them at the present stage of manufacturing technique.

No doubt readers will be able to add many other desirable things to the above list. No doubt, too, many of the problems will ultimately be solved, and it is our guess that when they are, we will enter into a new age in the application of radio to short-distance communication.

Frequencies Allocated for Model Control by Radio

We have much pleasure in advising readers that the Post and Telegraph Department has made permanent allocations of frequencies on which radio remote control may be carried out, subject to certain regulations.

The frequencies allocated are 27.12 mc/sec. and 35.7 mc/sec. The frequency tolerances are as follows:—

27.12 mc/sec. ...... 0.6 per cent.

35.7 mc/sec. ...... 0.75 per cent.

These tolerances mean that equipment must be operated inside the limits below:—

27.28 to 26.96 mc/sec.

35.43 to 35.97 mc/sec.

Other conditions of operation are as follows:—

(1) The power (D.C. input) to the final stage is not to exceed 10 watts.

(2) If modulation is used, the maximum modulation frequency must be such that no radiation extends outside the limits of the bands indicated.

(3) The level of radio frequency harmonics and non-essential emissions must be kept at the lowest value which the state of technique permits. In every case, the power of any harmonic or parasitic emission supplied to the antenna must be at least 40 db. below the power of the fundamental.

(4) No adjustments are to be available from the exterior of the transmitter other than switching devised for controlling the signals emitted.

In due course, all equipment used for the control of models will require to be type-approved, and a fee will be charged for each type of equipment submitted for test. Details in this regard will be furnished at a later date.

(6) Use of the equipment will be confined to persons not less than sixteen years of age.

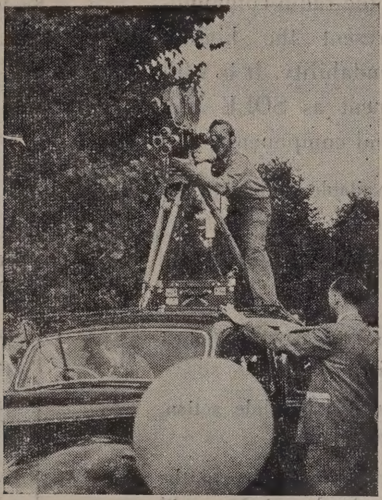
(7) In the meantime, any equipment on the above frequencies must be used under the direction of a licensed radio amateur.

It is not unlikely that some other ultra-high frequency may be made available later in the year.

Making A Film For Television

By P. H. DORTE, who is head of Television Films, part of the British Broadcasting Corporation's Television Service.

There seems to be a universal misapprehension to the effect that a special technique is required when making a film for television. The truth is that with modern British flying-spot film-scanners, such as those now used by the British Broadcasting Corporation for televizing film, any film produced for the cinema can adequately be transmitted by television, and equally, any 35-millimetre film made for television can, from the purely technical angle, be projected in the cinema.



Filming scenes at a television garden party held in the grounds of Alexandra Palace, London. These were shown on television newsreel that same evening.

But it is possible to be less hidebound by convention when making films for television—to transmit, for instance, unmarried prints or even, in the case of documentary and news films, not to record the sound at all, but to transmit the commentary "live" at the time of transmission of the mute picture with music (if required) being simultaneously broadcast from disc. And because the bulk of the screen-time of any normal television service will come from "live" transmissions originating in the studios and at outside broadcast points, the producer of a film being made specially for television can take advantage of the limitations of "live" television and make his film less pretentious in consequence.

This last point needs amplification. Largely because the producer of a "live" television programme has to be extremely careful to ensure that the camera which is "on the air" does not show his second, third, and fourth cameras and because, clearly of course, he can but rarely use a reverse-angle camera because it would be seen by his frontal cameras, the tempo of a "live" television production is essentially slow.

The viewer looking-in on his home screen quickly becomes accustomed to this, and experience dictates that he does; in fact, get worried if, after viewing a live programme, he is suddenly shown a very rapidly cut motion picture. The moral here, then, is that a film for television is preferably taken in slow tempo—that is, with long takes—and that the reverse angle not only can, but actually should, be omitted. Further, because too many people invariably crowd round a television receiver which, anyway, has a comparatively small screen, long shots should be avoided, and the motto which directors and cameramen should wear next to their hearts is "establish only in long-shot or mid-shot, then get into close-up—and stay there."

PRECAUTIONS TO BE OBSERVED

Uniformity of gamma should always be aimed at, and, if it is known that the film is to be transmitted on a film-scanner incorporating a television camera subject to "tilt and bend," two further precautions should always be taken: the first is to avoid having any solid black object in the foreground on the bottom and right-hand frame lines; the second is to avoid cutting (as opposed to dissolving) from a picture with a high percentage of black content to a high percentage of white content—and vice versa. The omission of either of these precautions will result in the transmitted picture having a grey "fuzz" along these areas—an effect not unlike, but even more unpleasant than, photographic halation.

Everything that I have written above applies, of course, to every type of film which one can make for television. What I would like to discuss now is what types of film it is economic to make for television and, where applicable, to indicate by what means they should be made. But before I do this I must digress to evaluate the relative attractions of "live" and filmed television, and to emphasize the need for appreciation of the existence of what is known in the United States as the "kinescope recording," and what we in Britain know as the "telefilm."

And I do not think that I can do better than reproduce the words which I used when I addressed the British Kinematograph Society in London: "Why does the television broadcasting producer not film his programme in advance and thus not only ensure the broadcasting of a more polished performance, but so also present himself with the means of repeating them at will? Film technicians are frequently unsympathetic to my view, which is that it would be psychologically wrong and economically unsound.

"The theatre excepted, television broadcasting is the most intimate medium of entertainment yet devised by man, and there is unquestionably a very strong bond between the performer in the studio and the viewer in his home. Insert celluloid between them so that the viewer is watching not the performance of a living actor now, but a reproduction of his performance of a few days ago—and the bond is cut; the actor is no longer playing expressly for the benefit of each and every individual viewer; the link which always ties the stage-actor to his audience is missing; the personal appearance atmosphere is gone."

FINANCIAL CONSIDERATIONS

"Financial considerations bring one to the same conclusion—at any rate in Britain; omitting standard overheads in the shape of floor-space, technical salaries, electricity consumption, and so on, but including set-construction, costume-hire, and artists' fees, we can stage two performances of a given play, revue, or variety show, running one hour or more, and having its quota of star names, for as many hundreds of pounds as it would take tens of thousands of pounds to film with present-day methods and at present-day costs.

"This financial argument may not prevail in the future in the United States, as the cost of lines for a coast-to-coast television hook-up may well be so heavy that the combined cost of filming a programme and transporting a print from television station to television station may prove to be less expensive. As a compromise applicable to Britain, I do, however, see a future in playing a first performance 'live' at a peak evening viewing time and recording this and reproducing the record for subsequent daytime repeat performances.

"I would emphasize that this problem—if, indeed, it is a problem—is concerned mainly with the theatrical type of television programme; the outside broadcast of a big sporting event or even of an important occasion must essentially be transmitted 'live,' while the outcome is still uncertain, and anything may yet happen. The average studio talks programme would, on the other hand, probably suffer little, if at all, from pre-filming, unless it featured a particularly famous or prominent personality whom viewers would feel they would like to be meeting in the flesh; in that case, 'live 'television provides the next best thing, and, at the same time, keeps the cost down to a reasonable level."

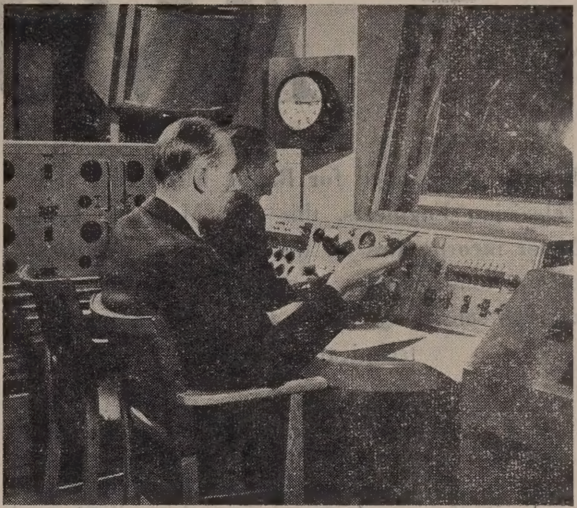
There is an old English saying to the effect that "the proof of the pudding is in the eating." Applying this test to this particular problem, I can say with full assurance that the Television Service of the British Broadcasting Corporation has proved time and time again that, where theatrical performances are concerned, "live" television wins all the time. . . . A popular film star appears in a "live' televized play: the whole television world talks the next day of the stars' performance. Televize instead a film featuring that same star, and nobody even mentions the transmission afterwards.

REPEAT PERFORMANCES?

It is clear, then, that a dramatic performance should be televized "live." What is not yet entirely clear is whether any repeat performance should also be televized "live," or whether it is adequate if a recording (a telefilm or kinescope) is made of the "live' performance, and this recording transmitted for the benefit of those viewers who were unable to see the original; until we have drawn up an agreement with the various artists' unions concerned about the "repeat fees" which artists should receive for each retransmission of a telefilm, we cannot gain experience in this field, but I myself suspect that the answer will be that repeat performances by telefilm will be acceptable.

If this is right, it eliminates the need for feature films (I use the word "feature" in its cinematic sense) to be made for television by film-production methods; television will automatically make its own features via the television camera and the telefilm recording equipment—and this will apply equally to dramatic and musical subjects. The reader might well ask, then, what there is left for the "straight" film camera to do. The answer is three things:

Firstly, to make film sequences for incorporation in otherwise "live" studio dramatic productions—to



Inside the mixer room of B.B.C. Television Service at Alexandra Palace. Here commentary, music, and effects are blended and controlled before being recorded on the sound track.

film exterior establishing scenes and sequences to be woven into the "live" production so skilfully that the viewer is, unless he thinks about it, unaware of the fact that for a short given period he is, in fact, looking at film at all. . . . The secret for the making of this type of film is to match the film scenes as closely as possible to the "live" television scenes subsequently to be produced in the studio—this in respect of both length of "take" and selection of camera-angles.

Secondly, to make newsreels—not wholly dissimilar in character to the cinema newsreels, but even more topical, and with each subject treated at greater length. The British Broadcasting Corporation Television Newsreel, for instance, frequently includes on a given evening events which have happened only that very afternoon and, in an overall footage of 1400 feet (426 metres), it may well allocate 500 feet (152 kilometres) to one story deserving that length.

"FOREIGN CORRESPONDENT"

Thirdly, to bring to the television screen stories which are worthy of more than the few minutes which is all that can be allotted to them in a newsreel, but which, equally, occur beyond television outside broadcast range or which call for several locations. A good instance of what I mean is the British Broadcasting Corporation television programme called "Foreign Correspondent." In this a reporter and a cameraman roam the world to bring back

(Continued on Page 48.)

The Design of Exponential Horns for Loading High-frequency Cone Speakers

By A. A. BROWN, A.M.I.C.E.

Several articles have been written on the advantages of using dual speakers and on the construction of crossover networks and vented baffles. Reference has been made to the desirability of loading the high-frequency speaker with a horn to avoid the pronounced "beaming" which would otherwise occur. A simple method of designing straight-sided, multicellular, exponential horns for this purpose is described below.

An exponential horn is one in which the cross-

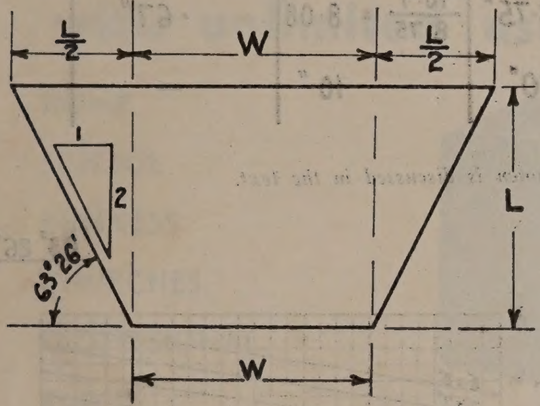


FIG. 1

sectional area is doubled at succeeding regular intervals, i.e., if the throat area is a, then at n intervals the cross-sectional area A will be $A = 2^n a$. If the length of the horn is L, then the number of intervals, n,

$$= \frac{\log A - \log a}{\log 2}$$

and the interval length, $I, = \frac{L}{n}$

The horn required to load a "tweeter" may be quite short, and construction is simplified if the sides are kept straight, diverging at an angle of about 60°. In this case, an angle of 63° 26′, or $\cot^{-1} \frac{1}{2}$, has been chosen to reduce calculation to an absolute minimum, as for any length of horn, L, the increase in width due to *each* sloping side is exactly *half this length* (see Fig. 1).

In designing the horn, the first step is to determine the throat area. This should, very roughly, be equal to the area of the moving part of the speaker cone, in a similar manner to the calculation of the vents in a vented baffle. For example, if it is proposed to use a nominal six-inch speaker as a "tweeter," a suitable size of throat opening would be 5 in. x 5 in. By referring to the graph, it will be seen that, if a length of 5 in. is chosen for the horn, the interval length, $I, = 2\frac{1}{2}$ in. This "square" design produces a nicely-proportioned horn, and has the advantage of being very simple to calculate.

Draw a full-sized plan of the horn on a sheet of paper and divide it off in interval lengths from the throat. In our example, the interval length is $2\frac{1}{2}$ in., so there are exactly two intervals in the horn length. Half intervals of $1\frac{1}{4}$ in. may also be drawn in. Then draw up a calculation sheet headed as shown. The table may be filled in as follows:—

Area at throat, a, = 5 in. x 5 in.	= 25.00 sq. in.
Area at first interval is twice this	= 50.00 sq. in.
Area at second interval is twice this	= 100.00 sq. in.
Area at first half-interval = $a \times \sqrt{2}$ = 25 × 1.4142	= 35.35 sq. in.
Area at second half-interval is twice this	= 70.7 sq. in.

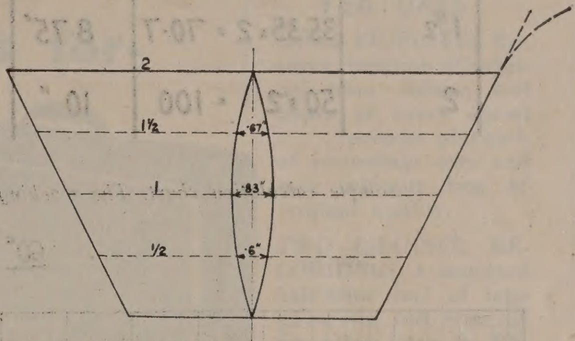


FIG. 2

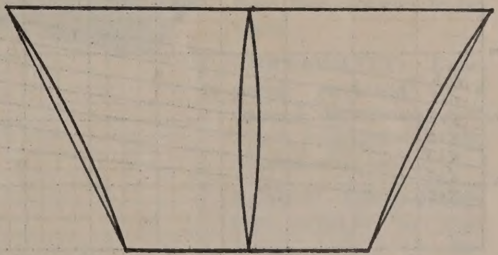


FIG. 3

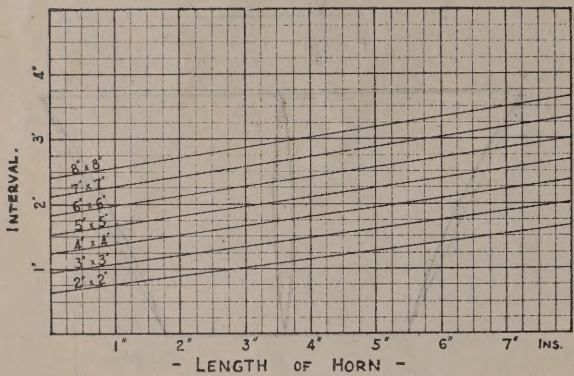
Now, divide the exponential area by the depth of the horn at each point to obtain the width required. It will be noticed that at the points between the throat and the length adopted the area of the simple straight-sided horn is *in excess* of that for a true exponential. Plot the excess widths equally about the centre-line of the horn, and join the points thus obtained with a fair curve. This will give a full-sized plan of a "streamlined" partition which now divides the unit into twin exponential horns (Fig. 2). By continuing the calculation beyond the nominal length of the horn, it will be seen that beyond this length the horn is *deficient* in area, and a true exponential can only be provided by flaring out the sides. This should be allowed for when mounting a small horn on a thick baffle.

Innumerable variations of design are possible, limited only by the ingenuity of the constructor. For example, by using thicker timber for the sides and shaping the

INTERVAL	EXPONENTIAL AREA	DEPTH	WIDTH	WIDTH REQUIRED	DIFFERENCE
0 (THROAT)	5" x 5" = 25□"	5"	5"	5"	—
½	25 x 1.414 = 35.35	6.25"	6.25"	$\frac{35.35}{6.25}$ = 5.65"	.6"
1	25 x 2 = 50□"	7.5"	7.5"	$\frac{50}{7.5}$ = 6.67"	.83"
1½	35.35 x 2 = 70.7	8.75"	8.75"	$\frac{70.7}{8.75}$ = 8.08"	.67"
2	50 x 2 = 100	10"	10"	10"	—

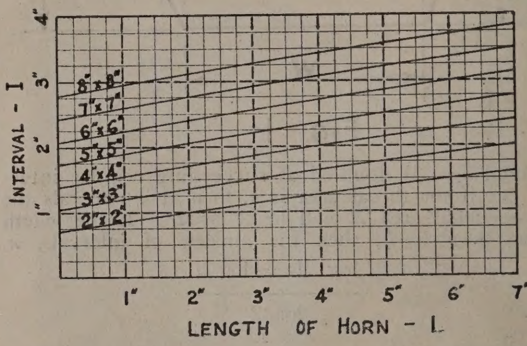
Sample calculation chart. The working shown is discussed in the text.

60°



Interval length plotted against horn length, for various throat dimensions, for an angle of 60°.

63° 26′



Interval length plotted against horn length for various throat dimensions, and an angle of 63° 26′.

inner faces, two more symmetrical exponential horns can be made (Fig. 3). Horns may also be constructed with only two or three sides sloping. In these cases, a slightly longer interval than that shown in the graph must be used.

Having drawn the full-scale plan, all that remains to be done is to construct the horn, bearing in mind that the plan shows the *interval* dimensions of the horn. Strong plywood, glued, screwed, and varnished, is suitable for the sides, with the centre partition shaped from a solid piece of timber. Attach a base-board big enough to hold the speaker and the job is done! As with the vented baffle, although a neat and workmanlike job is worth while, it is quite unnecessary to work to micrometer accuracy in order to obtain highly satisfactory results. (For strict mathematical accuracy, the length should be measured along the centre-line of *each* exponential horn and the widths perpendicular to it, not the common centre-line of the double unit.)

—A. A. Brown, A.M.I.C.E.

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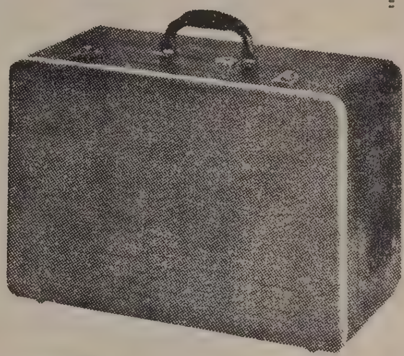

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A Philosophy for Listening

The search for perfection in high-quality reproduction is an art that has many adherents, from the schoolboy with plenty of enthusiasm and no money to the connoisseur who can afford to purchase the very finest in equipment and technical assistance for the purpose. Between these two extremes comes a whole host of people among whom can be numbered practically every radioman during some stage in his career, and the fact remains that, once bitten by this bug, he never completely recovers. There is an attraction about high-fidelity sound that few other aspects of radio can offer.

This attraction seems to be that completely natural sound reproduction is always just out of reach, despite all the time and effort that have been put into the subject. The reasons for this are many and varied—modern amplifiers achieve a high degree of fidelity and add little or no coloration to the sound, but pick-ups, microphones, speakers, records, and listeners are very variable indeed, and by no means the least of these is the last-named.

One thing the schoolboy with his makeshift equipment and the connoisseur with his elaborate gear have in common is the ability to convince themselves that they have the ultimate in reproducing means. This, then, being the case, the ability to appreciate reproduced music becomes a condition of the mind rather than conformity to any fixed standards. True enough, equipment is available to measure the frequency response of amplifiers, to tell the amount of intermodulation distortion present, also harmonic distortion and a host of others too numerous to mention, but it all comes down to one thing—how it sounds to an individual listener, and that is the final test.

It seems quite certain that no two people hear an orchestra in the identical manner; indications are that our own ears add quite an amount of distortion on their own account, but this cannot be considered tremendously important, since we have to live with our ears anyway, therefore natural sound and reproduced sound must suffer equally; but it could account for the difference between two listeners.

What is a variable factor in any one listener, however, is the condition of mind at any particular listening session. The writer has noted varying listening habits in himself with some interest as follows: After a heavy day at the usual business grind where fatigue can mostly be considered as mental rather than bodily, the "Walrus" has retired to the comfort of an armchair prepared to listen to a programme of favourite records and extract full enjoyment and relaxation from them, only to find that everything seems to have turned sour. The notes appear to jangle and not come true. Treble does not seem clean and bass not full and round enough. In such a thwarted frame of mind, there is only one thing to do, and that is to switch off and forget it all.

At other times, though, notably after a vigorous day in the garden, hoeing, digging, mowing the lawns, etc., when the bodily fatigue can't possibly be in doubt, the same records can be listened to with complete enjoyment. This state of affairs has been noticed not once but many times, always on the same equipment, which to the best of knowledge is not variable. It would seem, then, beyond all doubt, that one's mental approach to wide-range listening has a very material effect on listening enjoyment.

Another aspect of high-fidelity sound is the actual amount of pleasure to be derived from listening to extended top and bottom frequencies. It must command full attention, and as an electronic accomplishment is interesting, but for full enjoyment over a long period becomes something of rather doubtful advantage. One is reminded of the tale of the sound engineer who had to have two sets—one a full-blown wide-range instrument to prove to his friends what he could do, and another of very average characteristics to listen to for 90 per cent. of the time and preserve sanity in the home.

The diehards will say that record scratch and kindred "noises off" are unimportant and that the true devotee of high-quality sound can condition himself not to notice these faults, but one feels that subconsciously these defects are noticeable, just the same as we appear not to notice the ticking of a clock in a room until suddenly it stops, when we immediately become aware that it is missing.

This article is not intended as discouragement to high-fidelity enthusiasts, but rather to call for a saner approach to the whole business and to seek a compromise between pleasurable and fanatical listening. Most probably, in attempting to increase frequency ranges and reduce known forms of distortion, we are introducing defects which far outweigh the small advantages obtained. Be that as it may, the "Walrus" suggests your next experiment should be to mow the lawns at a furious rate, then come in and listen to your amplifier, esconced meanwhile in a comfortable chair with a deep, cool ale on hand to heighten the pleasure. Should this prove a failure, you may console yourself with the thought that the lawns needed doing and anyway the thirst-quencher was worth it!

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Some New Circuits for Radio Control Receivers

Two years ago this journal featured several articles describing equipment which could be used for the remote control of models, or other devices, by radio. Since that time, several advances in technique have been made; these are described in the article below, which those interested in this fascinating radio sideline should find both interesting and useful.

INTRODUCTION

The remote control of devices over a radio link is a topic which has a peculiar fascination of its own, and which has had to wait several decades before being successfully accomplished. As can be imagined, however, present-day radio and control circuits make remote control a relatively easy and straightforward matter, particularly in cases where there is little or no restriction placed on the size and weight of the equipment, and where there are no limitations to the power that may be used to operate either the radio gear or the mechanical devices associated with it. Where unlimited power is available, and when size and weight are unimportant, designing remote-control equipment is simply a matter of assembling a collection of equipment, each part of which has been designed for an individual and separate part of the whole job. For example, innumerable methods are available by which one radio carrier may be used to transmit a number of control signals, each controlling a different part of the finally controlled device. Similarly, if such control consists of adjusting the positions of a number of shafts, then any mechanism which enables one shaft to be controlled may be duplicated for controlling the remaining ones.

In applying well-known principles to cases in which size and weight must be kept to a minimum and in which dry batteries are almost the only form of power supply practicable, however, we come up against problems which otherwise do not occur. Such a case is the application of radio to the control of models, and, in particular, to model aircraft. Here, space and weight considerations have the greatest possible importance, and impose so many restrictions on the design of the radio equipment, that the whole problem takes on a somewhat challenging aspect. Indeed, one has to make use of almost every known device in order to make any improvements or advances on techniques which have already shown themselves to be practicable.

SUMMARY OF WORK TO DATE

A full description of the history of radio-control equipment for models is beyond the scope of this article, but for the benefit of those who are reading about it for the first time it is felt that a little at least should be said about the present state of the art.

At the outset, it can be said that the only type of receiver that is in use for the purpose is the super-regenerative detector. This follows at once from the fact that this type of receiver offers the greatest sensitivity in the smallest number of valves, and for the lowest power consumption. The ordinary regenerative detector is neither sensitive enough, nor stable enough to merit consideration, while the superheterodyne, while infinitely desirable from many points of view, is completely ruled out on the scores of complexity and the battery weight which would be required.

A further great advantage of the super-regenerative set is the strong inherent A.V.C. action, which enables very stable performance to be had, right up to the extreme range of which it is capable.

In Great Britain, a number of commercial radio control receivers are available, practically all of which use a specially designed sub-miniature thyratron in a self-quenching super-regenerative circuit. These receivers are extremely light, and can be operated from very light dry batteries on account of their low current drain, but, to judge by the literature on the subject, they suffer from a number of disadvantages. In the circuits used up till now, the life of the valve, the XFG1, has been extremely short, and not at all predictable. In addition, extremely sensitive relays are required, and it appears that, in order to produce the complete control system at a price that buyers can afford to pay, cheap sensitive relays have to be used which are not sufficiently trouble-free. These receivers also suffer from a necessity for critical adjustment of the aerial loading on the detector circuit and for a similar critical adjustment of the standing current of the valve in the absence of a signal. On several counts, then, these sets, while sold in fairly considerable quantities, are not nearly as satisfactory in actual use as modern radio equipment should be.

In fairness, it should be stated that Judd[1] has written that most of the unsatisfactory features of existing XFG1 receivers can be eliminated by proper circuit design, and this writers' reasons for the unsatisfactory performance of the present sets sound convincing, to say the least.

However, the author considers that the use of the special thyratron is not a good solution to the problem, even if more satisfactory performance can be obtained, if only because of the necessity for a very sensitive relay, which, unless expensive, is bound to be less reliable than a more robust one, requiring more power to operate.

Accordingly, the author's development has been along similar lines to those of L. H. Wright[2], whose receivers are all based on the requirement that they must be able to operate a relay which pulls in at a coil current of four milliamperes or more.

RECEIVERS USING CONVENTIONAL MINIATURE VALVES

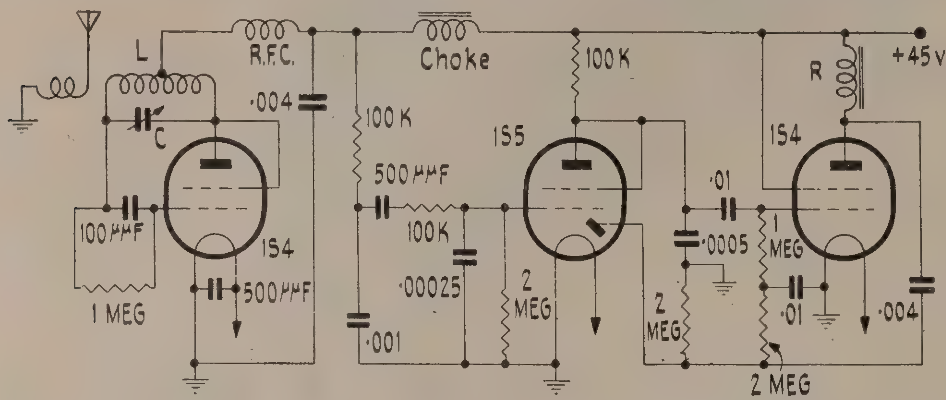
Numerous attempts have been made to design super-regenerative detector circuits which exhibit a large enough plate-current change on receipt of a signal to operate a relay directly, but there is no evidence to date that any of these have been really successful. The writer has tried several arrangements that have been published, and has come to the conclusion that **if genuine super-regenerative action is taking place, there is no possibility of operating a relay directly in the plate circuit.** There is undoubt-

edly a condition in which relatively large plate-current changes occur when an R.F. signal is applied and removed, but this condition is extremely unstable and erratic in performance and is almost impossible to reproduce. Such conditions obtain when the detector is on the border-line of super-regeneration, and it is the writer's belief that the current change obtained is always due to one of two things: Either the receipt of the signal induces super-regeneration to occur, or else it inhibits a weak super-regenerative action. In either case, a relatively large plate-current change of several hundred microamps is obtained.

If reliable and reproducible operation is to be obtained, then the detector must be operating as a true super-regenerative. Either self-quenching or separate quenching may be successfully employed, but, in either case, the change of plate current in the detector valve is minute, and completely different means must be used to secure relay operation.

As was mentioned in earlier articles,[3] one principle that has been used with considerable success is that first described by Hull in 1936.[4] This consists in differentiating, electrically, between the two conditions of operation characteristic of the super-regenerative—the "noise" generated in the absence of a signal and the lack of it after a signal is applied. Hull's method (and that still used for most purposes by L. H. Wright and the writer) was to amplify the "hiss" up to a level where it can be rectified and applied to a relay valve, holding it close to cut-off, with the signal de-energized. When a signal is received, the hiss disappears, the bias on the relay tube is lifted, and the relay operates. This scheme has the advantage that an unmodulated carrier is sufficient to operate the receiver.

A typical receiver of this sort, using a self-quenching detector and a stage of audio amplification ahead of a reflexed relay tube, is shown in Fig. 1. In this circuit, it will be seen that resistance-capacity filters of quite large time-constant are used between the detector and the first audio stage and between the latter and the relay valve, which also acts at the same time as an audio amplifier. These filters are essential to successful operation of the circuit, since they suppress the "squegging" frequency, which, if allowed to be amplified, will completely mask the super-regenerative noise and spoil the operation, since the relay tube would then remain permanently biased off, regardless of the presence or absence of a signal.



Self-quenched detector, with audio and relay circuit for unmodulated carrier operation, due to Mr. L. H. Wright. Note the heavy R.C. filtering between stages to remove the quench frequency, leaving only the super-regenerative noise.

With a self-quenching circuit, it is not possible, without a great deal of trouble, to determine what the quench frequency will be, and, in any case, this frequency changes with the signal strength, so that it is not possible to use any sort of tuned filter to remove it. The R.C. filters, however, seriously restrict the A..F response, so that only low-frequency noise is left after the quench has been filtered out. This is not very important in itself, but does mean that in any application where A.F. response is important the self-quenching circuit cannot be used.

These self-quenching detector circuits are quite reliable once they have been set going, and will work well from an H.T. supply of only 45 volts. A disadvantage, however, is that, in order to take off the noise input, a small A.F. choke is necessary, and suitable components for this purpose are difficult to obtain. A plain load resistor cannot be used unless the B battery voltage is considerably higher than 45 volts, and in the interests of weight it is desirable not to increase the B voltage above this figure if at all possible.

Another major difficulty is that of microphonics, particularly when the circuit of Fig. 1 is used. This is important in the case of models powered by miniature petrol or "diesel" engines, since they impart considerable vibration to the structure of the aircraft, making mechanical isolation of the receiver essential. Even with the receiver slung in rubber suspension bands, receivers like that of Fig. 1 are sometimes found to be unworkable unless the detector and audio valves are specially chosen for low microphonic effect. Thus, although perfectly satisfactory receivers can be built along these lines, they are by no means ideal. Even so, their reliability is beyond question excellent, which is more than can be said for the one-valve thyratron receivers.

A SEPARTELY-QUENCHED SINGLE-VALVE DETECTOR

In an attempt to combat microphonics, it was found that separately-quenched detectors were preferable, in general, to self-quenched ones, since the former produce considerably more "hiss" voltage, so that less A.F. amplification is needed. At the same time, it was thought that an arrangement in which one triode valve oscillated simultaneously at quench and radio frequencies would be simpler and lighter on A battery drain than if two separate valves were used. Accordingly, detector circuits like that of Fig. 2 were devised, and several workable sets based on

this detector were built and operated. The circuit does enable the detector to give a greater noise output than the self-quenching type of circuit, but not very much more. Moreover, after considerable experience with the circuit of Fig. 2, it was decided that it was not easy enough to reproduce to make it really worth while. The reason for this behaviour is simply that a critical balance between the circuit

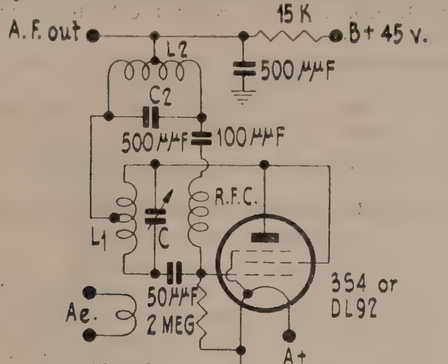


Fig. 2

values has to be struck in order that both oscillations shall take place at all. When the requirement is added that the two oscillations must have a definite amplitude ratio in order to make the circuit super-regenerative, the result is that the circuit is undoubtedly a "tricky" one; interesting, but not the sort any manufacturer would be keen to put into production! At the same time, it is clearly not as suitable as it might be for the amateur experimenter, since its performance is not entirely predictable.

A SEPARATELY-QUENCHED SINGLE-VALVE OSCILLATORS

It was considered that the unpredictable performance of the circuit of Fig. 2 was entirely accounted for by the "combination" nature of the arrangement. If entirely separate oscillators could be used for the signal frequency and the quench frequency, it was argued that each could be made to perform well, as an oscillator. From there, obtaining good super-regeneration would be only a matter of suitably modulating the signal-frequency oscillator with the low-frequency one. In practice, this turned out to be the case.

The circuit of Fig. 3 was evolved and was found to be extremely non-critical in operation, and to enable excellent super-regeneration to be obtained very easily. The right-hand section of the 3A5 is the low-frequency oscillator. It employs a tapped coil, taken from a commercial coil originally designed as a beat-frequency oscillator for receivers having an I.F. at 100 kc/sec. This coil originally had a 100 μμf. condenser in parallel with it and a movable iron-dust core for fine tuning. With 500 μμf. in parallel instead of the original condenser, it resonated at approximately 50 kc/sec., which was the quench frequency decided upon. The coil had a tapping at approximately one-third the number of turns from one end, and the smaller portion of the coil was included between the grid and B plus. With the circuit values shown, the peak oscillator voltage across the coil was found to be very nearly equal to the D.C. supply voltage, so that at the plate of the oscillator there was about 30 volts peak.

The left-hand section of the 3A5 is a conventional tickler-feedback oscillator, working at the desired radio frequency. There was no particular reason for the choice of this oscillator circuit, except perhaps to demonstrate that the type of oscillator circuit is quite unimportant as long as it is a reasonably efficient oscillator. The experimental work was carried out on the 50 to 54 mc/sec. amateur band, so that

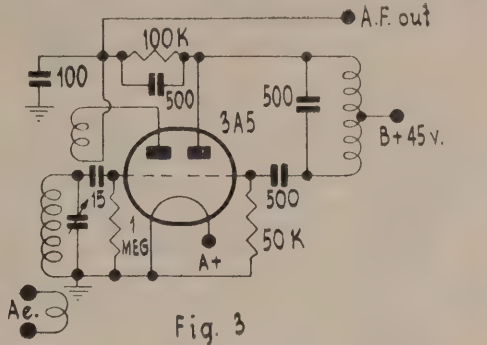


Fig. 3

Left: Separately-quenched detector circuit using the same oscilllator valve for both frequencies. Above: Improved circuit using entirely separate oscillators in a separately-quenched detector circuit.

no difficulty was experienced in getting the tickler-feedback oscillator circuit to function satisfactorily. At higher frequencies, of course, a Colpitts or Ultra-Audion circuit would probably be more satisfactory. The "cold" end of the tickler was bypassed to ground by a 100 μμf. condenser, in the ordinary way, and after making sure that the oscillator functioned, by connecting this point directly to 45 volts, it was then fed from the plate of the quench oscillator through a 100 k. resistor, bypassed by a 500 μμf. condenser. The resistor drops the D.C. plate voltage of the R.F. oscillator well below 45 volts, while the bypass condenser applied the alternating voltage at the plate of the quench oscillator, directly to the R.F. oscillator circuit.

It can be seen that this arrangement modulates the plate voltage of the R.F. oscillator between two values that are widely spaced enough to cause the R.F. oscillator to go in and out of oscillation during each cycle of low-frequency oscillation. If either too little or too much quench voltage is being applied to the R.F. oscillator, the amount can easily be changed, simply by altering the value of the condenser bypassing the 100 k. resistor. In a practical case, this might be necessary, since in each circuit that is built up, the R.F. oscillator will have slightly different feedback, owing to the difficulty of exactly controlling the amount of coupling between the tickler and the primary, and because of slight differences of aerial loading. However, the arrangement has been found very amenable to duplication. It has even been built using two triode-connected 1T5s instead of the 3A5, and in this case also no difficulty was experienced in making it super-regenerate properly.

MODULATED OR UNMODULATED OPERATION

The detector circuit of Fig. 3 can be used for receivers which have to work either with modulated or unmodulated carriers. For the former, it would be

possible to take the last two valves of the circuit of Fig. 1 and place them after the detector circuit. Rather less quench filtering would be needed with the Fig. 3 detector circuit, since the quench frequency is fixed, and is at a considerably higher frequency than is usually obtained in a self-quenched circuit. Because of this, and the fact that the noise output of the separately quenched detector is rather greater than that of the other, it might be found that the audio gain is excessive. This can easily be reduced by lowering the value of the plate load resistor of the 1S5 audio amplifier.

In doing this, the aim should be to use as little A.F. amplification as is consistent with getting a low enough minimum current in the relay tube for efficient operation of the relay. Some relays are difficult to use in circuits like these, because, although they pull in at low current—say, 4 ma.—they do not drop out until the current has been reduced to a very much lower current, say, 1 ma. These relays can only be used successfully in circuits where the current through the relay drops right to zero, but, usually, they can be modified so that the difference between the pull-in and drop-out currents is quite small.

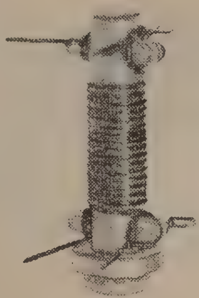
For the sort of circuit we are dealing with, it is desirable to have a differential of only about 1 ma., if possible. That is, if the relay pulls in at 4 ma., it should drop out at 3 ma. Then, if the minimum current in the relay tube is 1.5 to 2 ma., the relay will be sure to drop out when the signal is removed, and the noise biases the relay tube back again. A point worth noting is that, with this sort of receiver, the minimum relay-tube current rises as the batteries run down, and the maximum current falls. For this reason, there must be as much leeway as possible above the pull-in current and below the drop-out current of the relay, so as to ensure that the set will still work properly even when the batteries are partially run down.

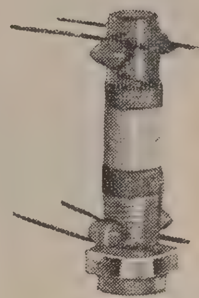
The idea of using an unmodulated carrier for the signal is very attractive, since it means a simpler transmitter, but, even so, the slight complication of having to modulate the transmitter can give a most excellent type of operation in the receiver, which almost eliminates the microphonic bugbear.

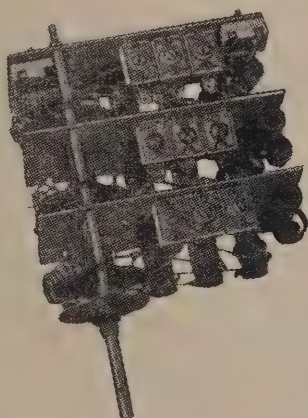
DEVELOPMENT OF A MODULATED-CARRIER RECEIVER

It had been noticed, when examining the output of a super-regenerative detector on the oscilloscope, that, at the instant of switching on of an unmodulated carrier, a large-amplitude switching pulse occurs in the plate circuit of the detector. This represents an instantaneous plate-current change of about 20 to 50 microamperes, which is as much as a properly working super-regenerative detector will give. Across a 100 k.

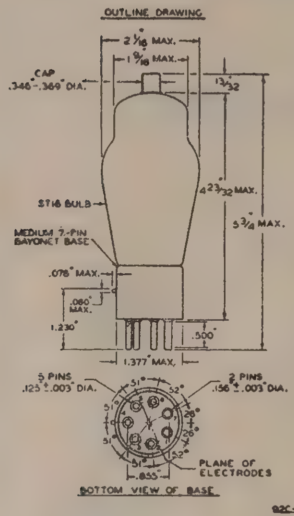
(Continued on Page 33.)



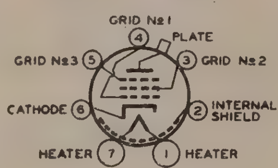




TUBE DATA: The 802 R.F. Power Amplifier Pentode



Tube Symbol and Top View of Socket Connections



The 802 is a pentode transmitting tube of the heater-cathode type for use as an R.F. amplifier, frequency multiplier, oscillator, and suppressor-, grid-, or plate-modulated amplifier. It may also be used as a Class A pentode amplifier or modulator. The plate connection is brought out through a separate seal at the top of the bulb to maintain low grid-plate capacitance. The suppressor and special internal shield are connected to individual base pins. In adequately-shielded circuits, neutralization to prevent feed-back is generally unnecessary. In R.F. service the 802 may be operated at maximum ratings at frequencies as high as 30 megacycles. The maximum plate dissipation is 10 watts.

CHARACTERISTICS

Heater voltage (A.C. or D.C.)	6.3	volts
Heater current	0.9	amp.
Transconductance (approx.):		
For plate current of 20 ma.	2250	microhms
Direct interelectrode capacitances:		
Grid-plate (with external shielding)	0.15 max.	uuf.
Input	12	uuf.
Output	8.5	uuf.
Bulb (for dimensions, see below)	ST-16	
Cap (for connection, see below)	Small metal	
Base (for socket connections, see below)	Medium 7-pin bayonet	

MAXIMUM RATINGS AND TYPICAL OPERATING CONDITIONS

As A.F. Power Amplifier and Modulator Pentode—Class A

D.C. plate voltage			500 max.	volts
D.C. screen voltage (Grid No. 2)			250 max.	volts
Plate and screen input			15 max.	watts
Typical operation:				
Screen input:			3 max.	watts
D.C. plate voltage	400	500	500	volts
Suppressor (Grid No. 3)	Conected to cathode at socket			
D.C. screen voltage	250	175	225	volts
D.C. grid voltage (Grid No. 1)	—18	—10	—17	volts
Peak A.F. grid voltage	18	10	17	volts
Internal shield	Connected to cathode at socket			
D.C. plate current	30	25	25	ma.
D.C. screen current	10	6	7	ma.
Load resistance	10000	18000	16000	ohms
Cathode-bias resistor	450	325	530	ohms
Total harmonic distortion	8	4	10	per cent
Power output	5.5	4	6.5	watts

As R.F. Power Amplifier Pentode—Class B Telephony

Carrier conditions per tube for use with a max. modulation factor of 1.0.

D.C. plate voltage		500 max.	volts
D.C. suppressor voltage (Grid No. 3)		200 max.	volts
D.C. screen voltage (Grid No. 2)		250 max.	volts
D.C. plate current		30 max.	ma.
Plate input		15 max.	watts
Suppressor input		2 max.	watts
Screen input		4 max.	watts
Plate dissipation		10 max.	watts
Typical operation:			
D.C. plate voltage	400	500	volts
Suppressor**	Conected to cathode at socket		
D.C. screen voltage	150	200	volts
D.C. grid voltage (Grid No. 1)	—22	—28	volts
Peak R.F. grid voltage	35	32	volts
Internal shield	Connected to cathode at socket		
D.C. plate current	25	25	ma.
D.C. screen current	6.5	7	ma.
D.C. grid current (aprx.)	1	0	ma.
Driving power (aprx.)†	0.5	0.18	watts
Power output (aprx.)	2.75	3.5	watts

As Suppressor-Modulated R.F. Power Amplifier—Class C Telephony

Carrier conditions per tube for use with a max. modulation factor of 1.0.

D.C. plate voltage			500 max.	volts
D.C. screen voltage (Grid No. 2)			200 max.	volts
D.C. grid voltage (Grid No. 1)			—200 max.	volts
D.C. plate current			30 max.	ma.
DC grid current			7.5 max.	ma.
Plate input			15 max.	watts
Screen input			6 max.	watts
Plate dissipation			10 max.	watts
Typical operation:				
D.C. plate voltage	400	500	500	volts
D.C. suppressor voltage (Grid No. 3)	—40	—53	—45	volts
D.C. grid voltage	—85	—90	—90	volts
Peak R.F. grid voltage	125	125	125	volts
Peak A.F. suppressor voltage	40	53	65	volts
Internal shield	Connected to cathode at socket			
D.C. plate current	18	20	22	ma.
D.C. screen current	28	28	28	ma.
D.C. grid current (aprx.)	7.5	5	4.5	ma.
Screen resistor†	9000	10700	10700	ohms
Grid resistor	11300	18000	20000	ohms
Driving power (aprx.)	0.9	0.6	0.5	watt
Power output (aprx.)	2	3	3.5	watts

As Grid-modulated R.F. Power Amplifier Pentode—Class C Telephony

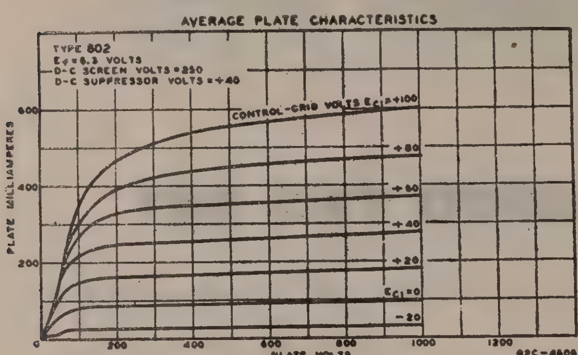
Carrier conditions per tube for use with a max. modulation factor of 1.0.

D.C. plate voltage		500 max.	volts
D.C. suppressor voltage (Grid No. 3)		200 max.	volts
D.C. screen voltage (Grid No 2)		250 max.	volts
D.C. grid voltage (Grid No. 1)		—200 max.	volts
D.C. plate current		30 max.	ma.
Plate input		15 max.	watts
Suppressor input		2 max.	watts
Screen input		4 max.	watts
Plate dissipation		10 max.	watts
Typical operation:			
D.C. plate voltage	400	500	volts
Suppressor**	Connected to cathode at socket		
D.C. screen voltage	150	200	volts
D.C. grid voltage	—105	—130	volts
Peak R.F. grid voltage	125	145	volts
Peak A.F. grid voltage	40	50	volts
Internal shield	Connected to cathode at socket		
D.C. plate current	25	25	ma.
D.C. screen current	7.5	8	ma.
D.C. grid current (aprx.)	2	1	ma.
Driving power (aprx.)†	1	0.8	watt
Power output (aprx.)	3	4	watts

As Plate-modulated R.F. Power Amplifier—Class C Telephony

Carrier conditions per tube for use with a max. modulation factor of 1.0.

	Pentode Connection	Tetrode Connection	
D.C. plate voltage	400 max.	400 max.	volts
D.C. supprsr. volt. (Grid No. 3)	200 max.	—	volts
D.C. screen voltage*	200 max.	200 max.	volts
D.C. grid voltage (Grid No. 1)	—200 max.	—200 max.	volts
D.C. plate current	40 max.	40 max.	ma.
D.C. grid current	7.5 max.	7.5 max.	ma.
Plate input	16 max.	16 max.	ma.
Suppressor input	2 max.	—	watts
Screen input	4 max.	6 max.	watts
Plate dissipation	6.7 max.	6.7 max.	watts
Typical operation:			
D.C. plate voltage	400	400	volts
D.C. suppressor voltage	40	—	volts
D.C. screen voltage*	195	85	volts
D.C. grid voltage	—40	—120	volts
Peak R.F. grid voltage	55	160	volts
Internal shield	Connected to cathode at socket		
D.C. plate current	35	35	ma.
D.C. screen current*	17	21	ma.
D.C. grid current (aprx.)	1.5	6	ma.
Screen resistor	12000‡	15000‡‡	ohms
Grid resistor	26700	20000	ohms
Driving power (aprx.)	0.1	0.9	watt
Power output (aprx.)	8	8	watts



As R.F. Power Amplifier and Oscillator—Class C Telegraphy

Key down positions for pulse without modulation††

	Pentode Connection	Tetrode Connection	
D.C. plate voltage	500 max.	500 max.	volts
D.C. suppessor volt. (Grid No. 3)	200 max.	—	volts
D.C. screen voltage*	250 max.	200 max.	volts
D.C. grid voltage (Grid No. 1)	—200 max.	—200 max.	volts
D.C. plate current	60 max.	60 max.	ma.
D.C. grid current	7.5 max.	7.5 max.	ma.
Plate input	25 max.	25 max.	watts
Suppressor input	2 max.	—	watts
Screen input*	6 max.	6 max.	watts
Plate dissipation	10 max.	10 max.	watts

Typical operation:					
D.C. plate voltage	500	500	400	500	volts
D.C. suppressor voltage	0	40	—	—	volts
D.C. screen voltage*	200	250	100	100	volts
D.C. grid voltage	—100	—100	—60	—60	volts
Peak R.F. grid voltage	155	155	90	90	volts
Internal shield	Connected to cathode at socket				
D.C. plate current	45	45	45	45	ma.
D.C. screen current*	22	12	15	15	ma.
D.C. grid current (aprx.)	6	2	7	6	ma.
Screen resistor	13600	20800	20000	27000	ohms
Grid resistor	16200	50000	8600	10000	ohms
Driving power (aprx.)	0.9	0.25	0.7	0.5	watt
Power output (aprx.)	14	16	10	12	watts

* For pentode connection, Grid No. 2; for tetrode, Grids No. 2 and No. 3 connected together.

** Applying a positive voltage of not more than 40 volts to the suppressor gives slightly increased output.

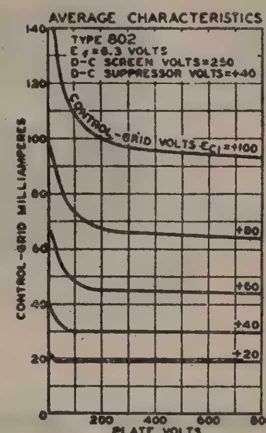
† At crest of A.F. cycle with modulator factor of 1.0.

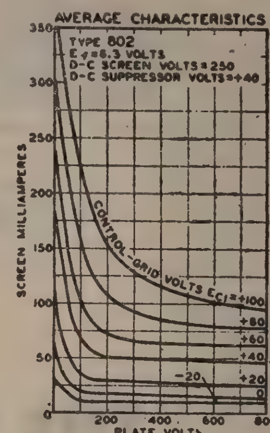
†† Modulation essentially negative may be used if the positive peak of the audio frequency envelope does not exceed 115 per cent. of the carrier conditions.

‡ Connected to modulated plate voltage supply.
‡‡ Connected to unmodulated plate voltage supply.

INSTALLATION

The base pins of the 802 fit the seven-contact (0.855 in. pin-circle diameter) socket which may be installed to hold the tube in any position. The plate lead of the tube is brought out at the top of the bulb to a metal cap. A flexible lead should be used to make connection to the plate cap so that a strain will not be placed on the glass at the base of the cap. Likewise, the cap should not be





made to support coils, condensers, chokes, etc. Under no circumstances should anything be soldered to the cap, as the heat of soldering may crack the glass seal.

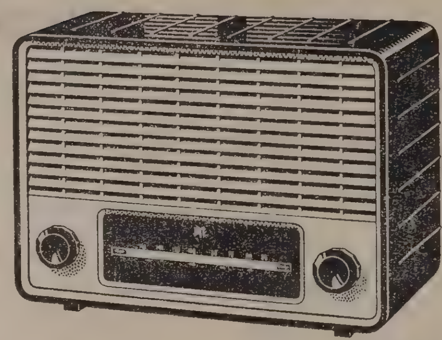
The bulb of this tube becomes very hot during continuous operation. For this reason it should not come in contact with any metallic body nor be subjected to drops or spray of any liquid. Free circulation of air should be provided.

The heater of the 802 is designed to operate at 6.3 volts. The heater supply may be either A.C. or D.C. A.C. is usually employed because of its convenience. The voltage across the tube heater terminals should be checked periodically. In radio transmitters during "standby" periods, the heater should be maintained at its rated voltage for convenience in promptly resuming transmission.

The cathode circuit of the 802 should be connected to the electrical mid-point of the heater circuit when the heater is operated from an A.C. supply. If cathode-bias is used, the cathode circuit should be connected to the same point through the cathode-bias resistor. When the heater is operated from a D.C. source, the cathode circuit is tied to the negative heater supply lead. In circuits where the cathode is not directly connected to the heater, the potential difference between them should not exceed 100 volts. If the use of a large resistor is necessary between heater and cathode in some circuit designs, it should be by-passed by a suitable filter network to avoid the possibility of hum.

The plate dissipation of the 802 (the difference between plate input and power output) should never exceed the maximum values given under Maximum Ratings and Typical Operating Conditions. *The plate should not show colour under any condition of operation.*

(To be Continued.)



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P18

THE EDITOR'S OPINION

The "Walchris" Super-Sound Gramophone Pick-up

Since the quite recent introduction of long-playing records to the New Zealand market, there has been even greater interest than usual, if that were possible, in record reproduction generally, and pick-ups in particular. It was thus with great interest that the Editor received for test and comment a sample of the "Walchris" pick-up, which hails from Denmark. The instrument follows the most modern practice in all its salient features, having a sapphire stylus, mounted near the end of a cantilever arm, and plug-in heads for 78 r.p.m. and long-playing records respectively. The heads are individually weighted so that the correct stylus pressure is automatically provided for the two types of record when each head is plugged into the tone-arm. As one has come to expect of high-quality pick-ups these days, the stylus pressure on the record is very low, in keeping with the extremely compliant suspension in the horizontal direction, at right-angles to the record groove. The wear on both record and stylus can thus be expected to be very small—a point which will commend itself to music-lovers who value their records.

PERFORMANCE ON TEST RECORDS

Unfortunately, 33 1/3 r.p.m. frequency discs are not yet available here, so that the following remarks are strictly applicable only to the 78 r.p.m. head. The test record used was H.M.V. ED1189. The pick-up had not the slightest difficulty in playing any of the cuts on this record, which extend down to 50 c/sec., nor were there any evidences of arm resonance, which must be well below this frequency. This is an important point, connected more with the design of the supporting arm than of the pick-up head itself, but it is one that by no means all commercial pick-ups succeed in coping with. At the same time, it is possible for arm resonances to occur at quite high frequencies, and these sometimes cause tracing difficulties, and distortion of the output waveform. At no frequency within the range of the record was any such tendency found, and it appears that the arm, and its socket into which the heads plug, are completely free from criticism on this score.

The useful frequency response was from 50 to 18,000 c/sec. Below 1000 c/sec., the response could be described as theoretically perfect. That is to say, the response was exactly that of the test record, right down to the lowest frequency, bearing out our first impression of its excellent tracking abilities. Above 1000 c/sec., a resonance was found at 17,000 c/sec. This was undoubtedly the resonant frequency of the stylus-armature assembly. Very occasionally, one finds a pick-up in which this resonance has been removed right outside the 20,000 c/sec. mark, where it can cause no trouble to anyone. But in this case, it was equally apparent that although the test record showed that the resonance existed, no other means would have detected its presence. The sound of normal 78 r.p.m. record hiss had that characteristic which is so hard to describe, but which all those who have had anything to do with good wide-range pick-ups will know. On a pick-up which, like this one, has a really extended frequency response, and which at the same time has no resonances of any importance, the amount of surface noise produced from 78 r.p.m. records is smaller, and at the same time is less obtrusive. Indeed, with the Walchris, new ffrr records sounded almost (but not quite) as quiet as L/Ps. It should be pointed out that the top resonance referred to above, did not, at its peak, exceed the response of the pick-up anywhere else in the range. This is why we consider it to be innocuous, quite apart from the fact that listening tests showed the high-frequency response to be as clean and unadorned as that of any pick-up we have heard.

LISTENING TESTS

Frequency response curves are notoriously misleading when it comes to assessing the value of sound-reproducing equipment, and however good a pick-up may appear on a frequency record and an oscilloscope, there is only one way of telling whether it is "good" or not; to listen to music from it, through the best amplifier and speaker equipment one can lay hands on. As it happens, we did our own listening tests, after the sample had passed the "ordeal by test record," as it might well be termed, but there is no doubt that we would have immediately classed it as a good pick-up, on first hearing. The reproduction, both of 78 and L/P records was exceptionally clean, and completely lacking in coloration due to the pick-up itself. The direct acoustic noise, or "needle-talk" as it is sometimes called, was so slight as to be almost inaudible at a distance of three feet from the turntable. This is a feature to which we attach considerable importance, for it seems that only very rarely does a pick-up which possesses it fail to measure up to very high standards in other respects. A lack of needle-talk cannot make an otherwise poor design good, but it can indicate the difference between one which is merely good, and another which is excellent. The noise itself, when it occurs, can be eliminated by closing the lid over the pick-up, and is not itself important, but the characteristics which make for its non-appearance also make for better tracking of the record groove, and therefore for low distortion and clean-sounding reproduction.

On L/P, listening tests were the only ones that could be applied, but these indicated that the L/P head is in no way inferior to its 78 counterpart. In both cases, standard equalization circuits were used, and a good indication of the similarity in performance of the two was that in spite of the widely different response curves of the two sorts of record, the performance sounded identical, except for the increased surface noise of the 78 r.p.m. discs, and this can hardly be blamed on the pick-up!

ONE SURPRISE

One surprising and very useful feature of these heads is their high output voltage. The maker's literature quotes this as 0.25 volts, rising to 1 volt and over on peaks. This was found, by actual measurement, to be quite true; it is a great advantage to the amateur constructor and the manufacturer alike, since it means that even after equalization, there is more output voltage left than some high-quality pick-ups give before it, and that one stage of amplification can be dispensed with compared with the very low-output types. Indeed, with an output voltage of this magnitude, it will be necessary to ensure that the first amplifier stage is not overloaded on loud passages, particularly if the equalizing network is placed after the first stage, and not directly after the pick-up itself.

To sum up, then, the Walchris appears to have everything the lover of recorded music could desire, and in our editorial opinion at least, is a first-class instrument of its kind, which will make a welcome addition to the local market.

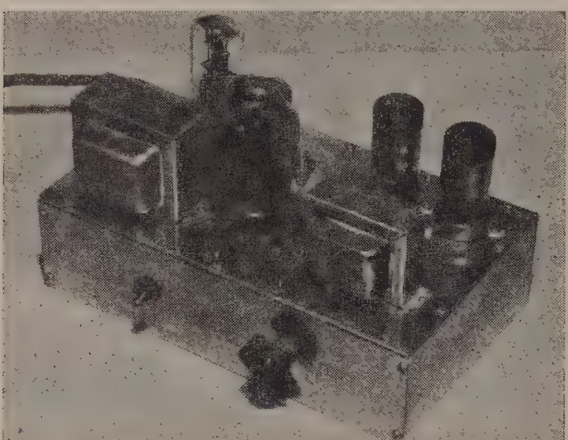
The PHILIPS Experimenter

An advertisement of Philips Electrical Industries of N.Z.,Ltd.

No. 55: Receiving Single Sideband (Concluded)

THE PRACTICAL CIRCUIT

With the above preliminary remarks, the action of the circuit shown here will be self-explanatory. The valves chosen for the detector circuit are Philips ECH21s. Their signal grids are connected in parallel and fed with I.F. from the plate of the last I.F. amplifier in the main receiver. Since push-pull oscillator outputs are needed, much the simplest way of doing this was to make use of the two triode sections as a push-pull oscil-



lator circuit. This is much simpler than having to use a separate oscillator, followed by a push-pull transformer. A common cathode bias resistor is used, and this is bypassed for audio frequencies. The screen grids are fed by a balancing potentiometer and two fixed resistors, in such a way that the pot. increases the screen voltage on one tube at the same time as it decreases the screen voltage of the other. This is the same scheme as was used in the transmitter for balancing the Philips EF50s in the double-balanced modulator circuit. For the output transformer (which incidentally cannot be done without) a small Class B input transformer is used, backwards, with the push-pull secondary used as the primary. The two oscillator sections of the Philips ECH21s are used in a special push-pull oscillator circuit which does not require a tickler winding. Its circuit is merely that of a multivibrator, with the addition of a tuned circuit between the plates of the two triodes. In an oscillator of this sort the balance between the two R.F. plate voltages is very good, which makes for very efficient addition of the outputs of the two valves.

The oscillator circuit is one noted for its stability when properly designed, but it is very little used, because we seldom have occasion for a balanced oscillator circuit, but here the situation is made to order for this particular arrangement. One advantage of the circuit is that the shunt feed resistors can be used simultaneously for dropping the D.C. voltage to a suitable value for the oscillator plates.

The Philips ECH21s are operated under the conditions recommended for superheterodyne mixer service, with one or two exceptions, due solely to the fact that the output is audio frequency. It is in order to preserve the proper electrode voltages, as well as to obtain proper phase addition of the audio outputs of the two valves, that transformer coupling is used in the output. We are afraid we must disappoint those who may have ideas of resistance-coupling the outputs. It just would not work, because not only would the desired audio outputs of the separate tubes not add together, but in addition, the undesired audio outputs due to rectification, would not cancel. The result would not, therefore, be particularly gratifying.

In order to make the unit self-contained, the experimental model was provided with a small audio output stage and a built-in power supply, but neither of these are essential to the working of the device. Those who do not wish to do this can omit both of these items, since the small power requirement of the ECH21s can be had from the main receiver's output tube, by feeding the output of the audio transformer to the grid of this valve.

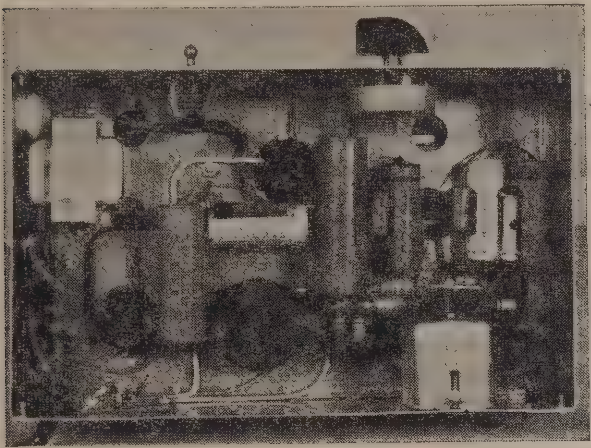
CONSTRUCTION AND ADJUSTMENT

The physical construction of the unit is not difficult, nor is it critical in any way. The photographs and the chassis diagram show how the pilot model was laid out, and it can be seen that the wiring of the mixer tubes has been done in as symmetrical a way as possible. The only component that might cause difficulty is the oscillator coil. The circuit used does not require that the tuned winding should have a centre-tap, and this makes the job easier. The coil was made from two commercial coils. One was an air-cored broadcast coil, and the other an iron-cored ditto, with a can and a *tunable* iron core. In our case, we removed the movable core and its mounting, and attached it to the former of the air-tuned coil turning it into a permeability-tuned one. An easier solution would probably be to purchase a slug-tuned aerial coil of the replacement type. This would have the necessity for altering the mechanical arrangements, and would work as well, although a slightly different size of fixed tuning condenser would be needed. The idea of using an aerial coil is that the inductance of the tuned winding is low enough to require 500 $\mu\mu$f. of fixed capacity to bring its tuning range within striking distance of 455 kc/sec. A low-C circuit like this, in conjunction with the push-pull feature of the oscillator results in a very stable oscillator, especially when the capacity is fixed, and frequency setting is done with the iron core.

In the photograph of the top of the chassis, the Philips ECH21s can be seen at the back right-hand corner, behind the coupling transformer. To the left of this is the

Philips EC31, and to the left again is the power transformer. Behind the power transformer is the Philips EZ35 rectifier. The single panel control is the 500k. pot. at the input to the EC31, while the switch is the one shown in the primary of the power transformer.

Under the chassis are the smoothing choke, in the front left-hand corner, the EZ35 socket in front of it, and directly to the right of this, the pre-set screen



potentiometer for balancing the ECH21s. The sockets of the ECH21s are almost obscured by the small parts that are wired directly to their lugs, and by the can for the oscillator coil. The latter is mounted on the back of the chassis, and beside it is the socket for the input lead. For the latter, a short piece of microphone cable or coaxial line should be used, no longer than necessary to go comfortably between the adapter, in its chosen position on the operating desk, and the receiver. If this lead is made too long, its capacity might be too high to trim out by adjusting the trimmer of the secondary of the last I.F. transformer in the set.

A point to remember about the ECH21 is that the metal ring round the bottom is connected to the cathode pin. It is important, therefore, to see that the socket used does not allow the ring to come into contact with the chassis, short-circuiting the cathode resistor. An Amphenol type of loctal socket, if installed so that the insulation stands proud of the top of the chassis will automatically look after this. However, if a wafer socket is used, the chassis immediately under the valve will need insulating. A simple but effective method of doing this is to stick cellophane tape round the socket hole.

USING THE UNIT FOR C.W. RECEPTION

In this capacity, the oscillator is used as a B.F.O., and a very good one it will make. There is a distinct advantage over the conventional B.F.O., in that code reception can be had with the R.F. gain at a much higher setting than in the receiver itself, in which it is always necessary to work with the audio gain up and the R.F. gain turned down, so as to get the best ratio of B.F.O. to signal voltage at the detector. The adapter will still do its trick of balancing out unwanted phone modulation, when it is used for C.W. reception, and for the C.W. enthusiast, the unit would be well worth building, even if he never wanted to listen to a single-sideband signal at all! With the adapter, C.W. reception with A.V.C. working is a really practical proposition, especially when a switch is provided which brings in an extra condenser in the A.V.C. filter, giving an exceptionally long time-constant. When this is done, the gain of the receiver does not have time to come up between words, and the annoying "breathing" that usually occurs when an attempt is made to use A.V.C. on code reception is eliminated, except at speeds under ten W.P.M. Incidentally, the main reason why A.V.C. cannot be used with most receivers for C.W. reception is that for A.V.C. to be effective, the R.F. gain control must be at maximum. When this is the case, the B.F.O. is not strong enough to give an audible beat note with the large I.F. signal that is present at the detector.

The adjustment of the unit once built, is very simple. The oscillator is first adjusted to exactly the I.F. of the receiver with which it is to be used. This can be done by using the oscillator as a signal generator, and tuning it to the receiver I.F., using the magic eye or the S-meter as an indicator of resonance. This done, the input terminal is connected to the plate of the last I.F. valve of the receiver by as short a piece of wire as possible, and the trimmer of this circuit is re-peaked to bring it back to alignment, which it will need because of the small amount of stray capacity contributed by the adapter. Next, the oscillator is de-tuned away from the I.F. by temporarily connecting, say, 0.001 μf. across the tuned circuit, and an ordinary A.M. phone signal is tuned in on the receiver. The modulation of this signal will be heard in the output of the adapter, because the balancing of the modulator has not been done. The screen potentiometer is then turned to the spot that gives *minimum* audio output, wherepon, with the oscillator circuit returned to normal, the unit is ready to go. The balance to A.M. signals will be quite sharp, and there will be no need to turn down the R.F. or I.F. gain on the receiver. When not in use for S.S.S.C., the adapter will make an excellent unit for receiving code signals.

If by any chance the audio output from the adapter should seem to be very small, it is as well to check the operation of the oscillator. If a V.T.V.M. is available, check the voltages at the grids of the oscillator sections. These voltages should be roughly equal at about 15 to 20 volts peaks. If there are any great discrepancies, such as normal voltage at one grid, and only a volt or two on the other, something may be wrong in the circuit. The most likely cause of such behaviour would be a fault in the oscillator coil. For instance, if there are some shorted turns, the valve on the same side of the coil centre as the place where the short is, will be the one showing the low oscillator voltage. To check whether any of the components are to blame, reverse the valves in the sockets, and test again. If the fault still occurs on the same side of the circuit, then one of the components must be at fault. For instance, an open grid condenser would cause the same behaviour that we have been describing. If, however, the fault should change sides with the tubes, then it is most likely that one of these is at fault, but with the well-known excellence of Philips valves it is hardly to be expected that this trouble will occur!

GETTING STARTED ON SINGLE SIDEBAND

We have heard some very complimentary remarks about this series of articles on S.S.S.C., since they were started, and we do appreciate them. If they succeed in getting a few enthusiasts to embark on this type of transmission, then it is felt that amateur radio will have been rendered a real service. On the other hand, if any of you who have read the series do feel grateful for the information or its style of presentation, then the expression of that gratitude that will please us most will be doing something about S.S.S.C. in a practical way. The circuits and methods that we have illustrated are by no means the only ones that can be used, nor are they necessarily the best, but they do work.

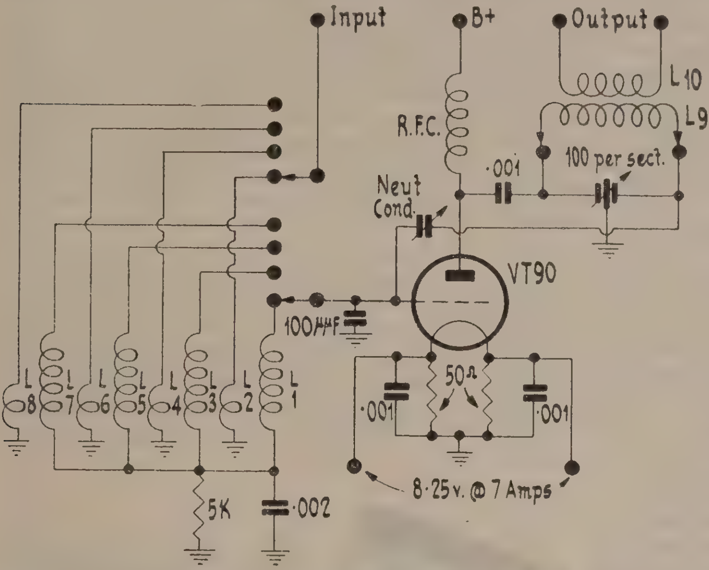
(Concluded on Page 48.)

A 100-Watt Final With A 12s. 6d. Tube

INTRODUCTION

These days, one often hears the complaint that there is nothing new in "ham" radio, unless it is single-sideband, or some such thing that is fit only for technical experts. We ourselves don't agree with this view at all, but even so, there is some truth in the statement, when it is applied to the equipment that is used for what are now the low-frequency bands as far as amateurs as concerned. That is to say, gear is pretty well standardized these days, and there is such a wide range of valves and other components readily available, and only waiting for the cash to purchase them, that a good deal of the old-time thrill has gone out of the business of building one's own gear. We do not suppose that this is true so much of the younger "ham"—at least we hope not, but for the older man whose chief joy once upon a time was to build a new and improved rig, has often given up experimental work in favour of "rag-chewing," and other activities more connected with the operating side of amateur radio.

Anyhow, it is with the idea of presenting something a little out of the ordinary that this article has been written. There are probably a good many of us who knew the old "micropup" only too well during the war, and who wondered how it would go as a "ham bottle." Well, fairly recently, large numbers of these tubes, which rejoice in the Service number of VT90, have appeared on the surplus market. We have not seen them retailing for more than 12s. 6d., hence the title of the article. Now, these tubes are not the easiest of tubes to "fire up," owing to a couple of rather special requirements, but if anyone is wanting something out of the ordinary to do, getting one of them going will certainly provide it for him. And, in spite of the tube's small size, there will be no need to think in terms of a pair in push-pull, because a single one is capable of taking the statutory 100 watts input several times over!



ABOUT THE VALVE

The VT90 is one of several valves developed just before, or in the early stages of the war, for radar purposes. These tubes had to have several rather special requirements. Not the least of them was the ability to work at the then almost unheard of frequencies of 200 mc/sec. and upwards. Unheard of, that is, when any amount of power was whispered in the same breath. This makes them of considerable interest to us for lower frequencies, for it is well known that a valve which is designed for V.H.F. will perform just as well at 10 metres as it will at 80. Again, they had to be able to turn out peak powers of ten and even hundreds of kilowatts. This does not interest us quite so much, because all we really need is a modest 100 watts input, but it is entertaining to know that we have plenty of tube capacity up our sleeves, as it were. Again, these kilowatts had to be made from the smallest possible tubes, and here our friend the VT90 really shines, because its over-all size is several times smaller than that of many conventional valves whose ratings are not a tenth as great. Indeed, no one who has not seen one of these tubes need fear that he won't find room for it in the shack. The trouble will rather be to find it, among the rest of the junk in the old box! It is what is known as an external-anode tube. That is, the plate is part of the outside structure of the thing. Note quite like the conventional water-cooled valve, because this time, the brass block, complete with cooling fins, that forms the plate, has two heavy glass tubes fused to it, one at each end. Through one of these come the two filament leads, while the grid lead comes through the other. The valves were designed to be used with long lines as tuned circuits, and in their radar application (they were used in a push-pull pair as the transmitter for the original A.S.V. sets) and for this purpose, the plate lines each consisted of silver-plated brass tubes, ending in clips, with thumb-screws, which held the plate of the valve firmly. The far end of the plate lines were mounted in

COIL DATA

80m. (1½ in. diameter former)

L_1, 30 turns 20g. D.C.C., close-wound.

L_2, 5 turns, same wire.

40m. (1½ in. diameter former)

L_3, 15 turns, same wire, winding length 1 in.

L_4, 3 turns, same wire.

20m. 1½ in. diameter former)

L_5, 10 turns, same wire, double-spaced.

L_6, 2 turns, same wire.

10m. (1½ in. diameter former)

L_7, 5 turns, same wire, winding length ⅞ in.

L_8, 1 turn, same wire.

Note.—All primary coils are wound over the lower turns of the grid winding. The 100 μμf. condenser from grid to earth on the circuit diagram should have been shown variable.

80m. Plate Coil

21 turns, 16g. bare copper spaced one wire diameter; diameter of coil 3 in., self-supporting.

a cylindrical insulating box, into which a blower forced a draught of cooling air. This travelled down the inside of the lines, and out through the cooling fins on the valves, so that the tubes acted as the tube mountings, their plate tank circuit, and the cooling device at one and the same time. Just in case the reader who is becoming interested might think that at the reduced powers under which we intend to work the tube, "blowing" will not be necessary, we are afraid we must disappoint him. We have not conducted tests, as yet, to determine whether they will stand up to unblown operation for more than a few minutes, but the specifications state that they must be air-cooled, even if only the filaments are turned on. So, you see, getting a VT90 going *will* be something a little out of the ordinary. Of course, the reason why all this attention must be paid to cooling is that the valve is so compact that its high-wattage filament alone is able to overheat it in the absence of some sort of air-stream.

A USE FOR THE VACUUM-CLEANER

In case by now most interested readers have been scared off, we can set their minds at rest by pointing out that in all probability they have a most excellent blower at home. It may be wanted during the day, but most wives we know of do not do the electroluxing at night, and if it is a modern one with provision for blowing as well as sucking, there won't even be any jacking up to do. The hose can be attached to the blowing end of the machine, and coupled up to the final through a short length of rubber hose, conveniently terminated for the purpose! Indeed, the blower we used in our own laboratory was none other than one made during the war by a well-known radio institution, from the motor of an actual vacuum-cleaner. All that had been done was to remove the dust-bag chamber, and retain the motor and centrifugal blower, which was then mounted up in a circular steel box, heavily lagged with carpet felt to deaden motor vibration!

SOME MORE ABOUT THE TUBE

Most radar tubes, designed specially for pulse work, were not given C.W. ratings, for if they had been, the permissible plate dissipation and output power would have been so small as to make the filament requirements quite ridiculous. The VT90, however, has got C.W. ratings, and quite respectable ones, too. Apart from the cooling, however, its greatest bug-bear for amateur use is that it requires about 60 watts of filament power, making the overall efficiency very low. But why should we worry about that? We do not intend to run it so long that it will push up the power bill unduly, and a 60-watt filament transformer is not at all a difficult thing to arrange, nor need it be a costly one. The voltage, 8.25, is an odd one, and the current is 7.5 amps, but most of us have an old 60-watt transformer core hanging about somewhere, and a simple (if we do it ourselves) and inexpensive (if we get it done) rewind will be all that we need, apart from the vacuum cleaner, to get the thing cracking.

The tube is a high-mu one, with low inter-electrode capacities, and neutralizes beautifully. Indeed, it lends itself much more readily than a conventional tube to a plate-neutralized circuit, such as is illustrated here. The driving power required is only of the order of 5 watts, and so need not hurt anyone. The grid current might look high, but it is not hard to get, especially if the recommended grid windings are used. We had ours putting a remarkably good glow into a 100-watt lamp with a grid current of 25 ma., provided by a single EL41 with 250 volts on its plate, and a plate input of 120 ma. at 600 volts. The measured power output was 45 watts, giving an efficiency of 62.5 per cent., which is not too bad, considering that the measurement was made across the actual load.

CONSTRUCTION OF THE UNIT

The construction of the final is quite clearly shown, for the most part, by the photograph on last month's cover of *Radio and Electronics*. The pipe, at the end of which the valve is mounted, is not a brass one, but a piece of bakelized paper tubing, such as is sold for coil former. Some mounting clips were made from 18-gauge aluminium sheet. These pivot in vertical slots in the end of the tube, and clamp the tube tightly by means of a bolt passing through the ends farthest from the insulating tube. The clips were bent round to the outside diameter of the plate block of the tube, and in order to provide a firm anchorage for the bolt, the ends were bent back, giving a double thickness where the bolt goes through.

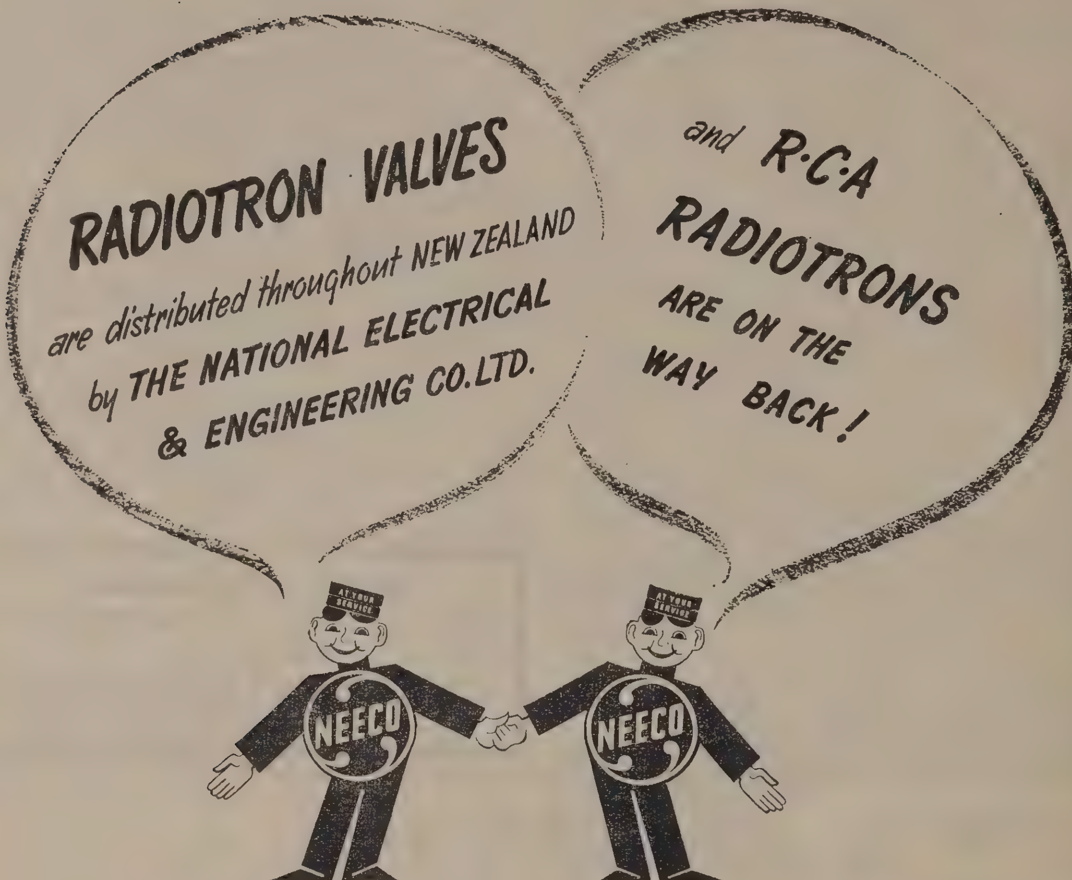
The tube is clamped with a filament end uppermost. This might be thought awkward, but it really is not, as it makes for a very convenient arrangement of the grid circuit, under the chassis. The plate tank condenser, and its sockets for the plug-in coils, are mounted on the chassis to the right of the tube. Parallel feed of the plate circuit allows the tank condenser to be grounded, and has several other advantages as well. A much smaller tank condenser, with narrower plate spacing could have

been used, but we did not have one at the time when the unit was built, and the rather large one illustrated was the only one we could buy at the time. We are all in favour, where plug-in tank coils are used, of isolating the tank circuit from the H.T. line, if only for safety reasons, but there are other advantages, too. Both the tuning condenser and the neutralizing condenser need only be insulated to withstand the peak R.F. voltage, and not the sum of the D.C. and peak R.F. voltages, as is the case with series-fed finals, except in the case where a blocking condenser is used between the plate and the single-ended tank condenser. Here, however, shunt feed is essential, because we are using plate neutralization. A very short lead from the plate tank to the neutralizing condenser results from the arrangement used, where the grid is under the chassis. Better still, it is possible to use coil switching for band-changing in the grid circuit, because no great lead lengths have to be accommodated when all coils are mounted under the chassis. The band switch control knob can be seen at the left-hand front of the chassis.

The filament wires do not terminate in pins, but are brought out as heavy, flexible leads. The arrangement for terminating them neatly can be seen quite clearly in the photograph. A piece of bakelized sheet is provided with a hole just large enough to slip over the neck of the tube. At each side, this small sheet of insulating material is provided with a double-ended, riveted-on solder-lug, and the filament wires are bent over and soldered to these. The joints should not be skimped, because of the rather large current they have to pass. The filament connecting leads come up through grommets in the chassis, and also solder on to the lugs. Please note the heaviness of the wires. Here again, 7.5 amps is not to be trifled with if unwanted voltage drop in the leads is to be avoided! The filament centre-tapping resistors are to be seen tied to a soldering lug which is mounted on the blower tube. A wire, which cannot be seen in the photograph, earths this lug. For keying purposes, the key or relay could be placed in this lead. The filament by-pass condensers are attached to the filament lugs at the top end, and to earthed soldering lugs at their lower ends. The plate-feed choke can be seen mounted on a small bracket near the front of the chassis.

PUTTING THE STAGE INTO OPERATION

It is certainly not necessary to say much about this phase of the business, because it is no different from any other Class C R.F. amplifier stage. Neutralization was ridiculously easy to attain, using any of the standard methods, and as mentioned above, the required drive is obtained very easily. There was no sign of regeneration or oscillation, even with no load at all, and the plate current dip, down to 25 ma. with 700 volts and no load, was as sharp as could be desired. Since the tube works well even with plate voltages as low as 500 volts, it will not be found difficult to provide a plate supply for it. We would recommend anything between 700 and 1000 volts, where 100 watts input is to be used, but for lower inputs, voltage as low as 400 can quite easily be used with excellent results.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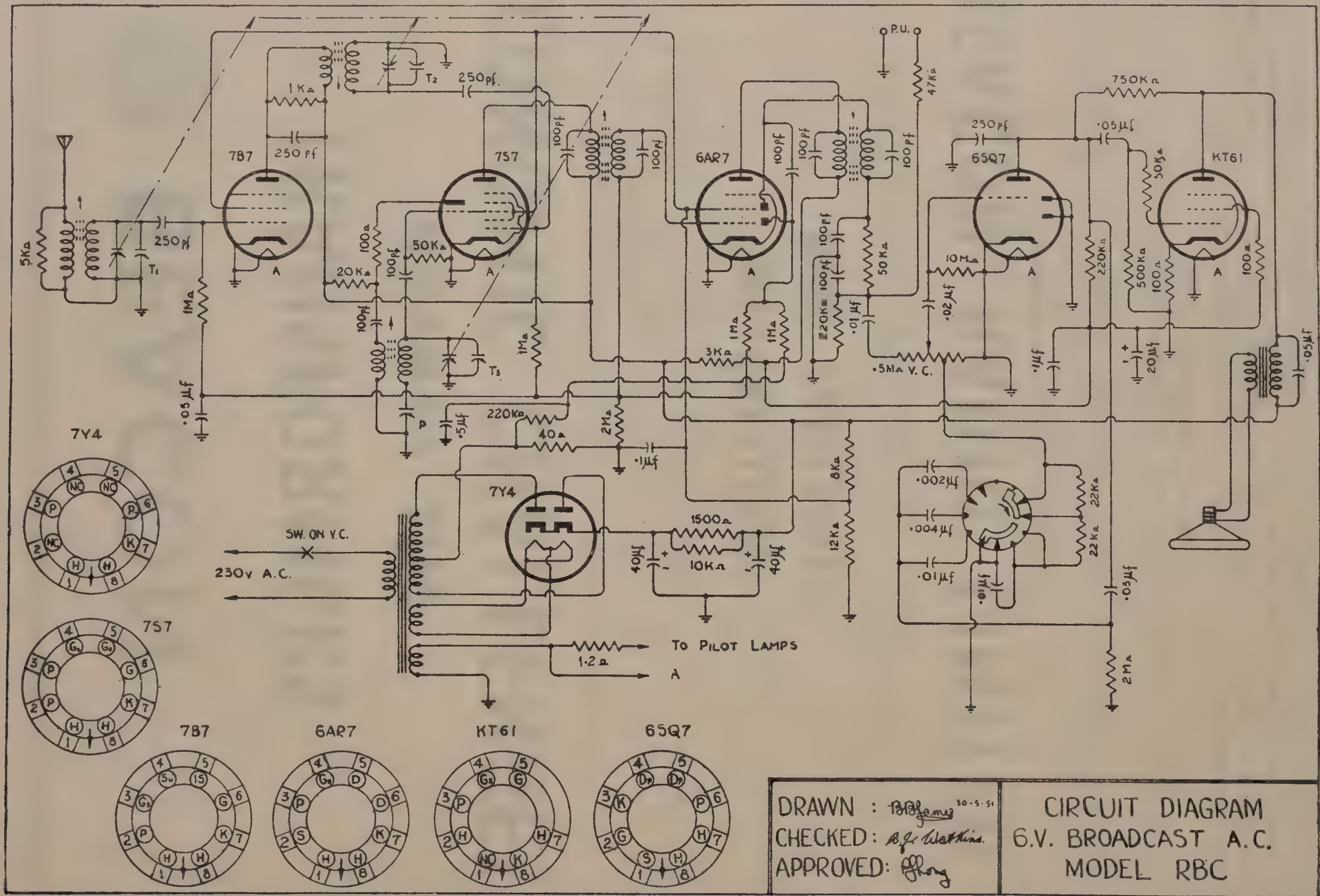


Radio Control Receivers

(Continued from Page 16.)

plate-load resistor, however, it represents a change of as much as four volts, so that, if it is made repetitive instead of occurring only when the transmitter is switched on or off, it should be possible to obtain an audio frequency output from the detector of about

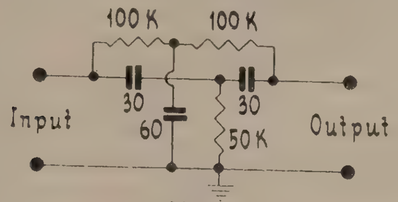


Fig. 4

Filter circuit, tuned to 50 kc/sec., for use with separately quenched detectors.

vibrator power supplies. This gives a square waveform to the H.T. supply voltage, at a frequency of about 100 cycles a second, and is equivalent to switching the transmitter on and off for equal periods of 1/200 second, as shown in Fig. 6. If the detector output is examined, the oscilloscope pattern is exactly as shown in this diagram. During the "on" periods, there is no super-regenerative noise visible, while on the "off" periods, the noise may just be discerned. The detector output, therefore, is a square wave, of

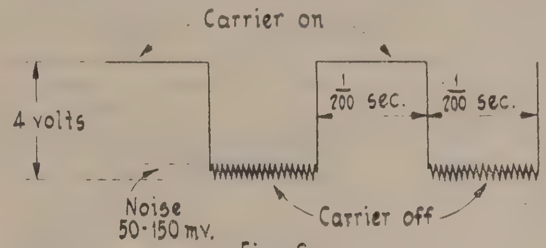


Fig. 6

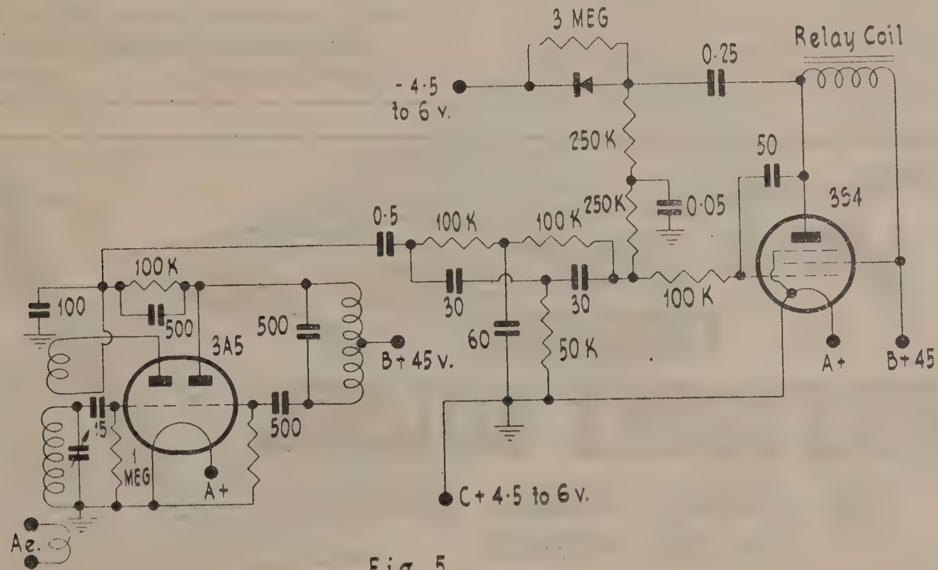


Fig. 5

Complete receiver for modulated carrier operation. It comprises the detector circuit of Fig. 3, the quench filter of Fig. 4, and a reflexed relay tube.

four volts peak to peak. This compares more than favourably with the 50 to 150 millivolts of hiss output, and is very much greater than the microphonic output which occurs when the detector is subjected to continuous and heavy vibration. In bad cases, this output is of the same order as that of the super-regenerative hiss, so that a valve is completely useless for the noise method of operation when this happens. With an output of two volts peak, however, any microphonic noise is completely negligible, and the receiver needs to be cushioned only on the score of protecting the valve filaments from fracture, on account of the vibration.

In order to make use of the large transient voltages which occur on receipt and loss of a carrier, a transmitter was modulated with a square waveform by the simple expedient of passing its H.T. supply through the contacts of a vibrator, such as is used in

frequency 100 c/sec. and amplitude about four volts peak to peak. This is almost, but not quite, large enough to operate a relay tube directly, after being rectified and smoothed, so that if the relay valve is to be used only as a D.C. device, a stage of A.F. amplification would still be needed. If this were used, it would almost certainly be possible to take the relay tube right to cut-off when the modulated signal is present. This type of operation would have the disadvantage that, in order to keep the relay de-energized, a continuous signal would be needed, which means keeping the transmitter on permanently, except when an initiating signal is to be sent. Then, and then only, would the modulation, or the whole modulated carrier, be interrupted.

In order to avoid this type of operation, and at the same time to remove the necessity for a third valve in the receiver, the following modification was tried. The relay tube was made to act as an audio amplifier, with the impedance of the relay coil acting as a plate load. The output at the plate is a highly distorted version of the square input wave, and this is rectified by a crystal diode, so that the D.C. output is positive in polarity. This output is fed back, after filtering to remove the A.F. component, into the grid circuit of the relay tube. A fixed bias of between 4.5 and 6 volts is provided for the relay tube by a bias battery. The bias battery reduces the plate current of the relay tube to about 2 ma. when no signal is present. When the modulated signal is applied, a small amount of positive bias is developed by the crystal diode, and neutralizes some of the fixed negative bias. This increases the amplification of the relay tube, so that the action is cumulative, and the plate current suddenly builds up to the maximum that the valve will pass with its 45 volts of H.T. supply. This amounts to 8 ma. with fresh batteries, dropping only to 7.5 ma. for the greater part of the batteries' life. The current change from 2 to 7.5 ma. is more than adequate to operate a robustly constructed relay pulling in at currents even as high as 6ma.

A complete receiver constructed along these lines is shown in Fig. 5. Between the detector and the relay-cum-amplifier valve is a filter, whose purpose is to remove the quench voltage from the output of the detector without affecting the 100-cycle square wave. For this purpose, ordinary R.C. filters would not be very satisfactory, because they would attenuate the higher audio frequencies so much that the waveform of the output from the detector would be ruined, resulting in a decrease in peak voltage. The network is a bridged-T circuit, tuned to 50 kc/sec. In practice, the quench oscillator coil's tuning slug is used to tune the quench oscillation to exactly the frequency of the filter. As long as the resistors and condensers of the filter are accurately chosen, the null at the tuned frequency is very sharp, and virtually no output at quench frequency remains at the output of the filter.

The use of such a filter, in combination with a separately-quenched detector circuit, is thought to be quite new, and, apart from its obvious usefulness in the circuit of Fig. 6, opens up some most interesting possibilities, which will have to be left for a later article. (To be continued.)

Notable "Ham" Function in Wellington

On Monday, 4th April, Bob Black, ZL2BX, was host at a gathering convened for the purpose of meeting one of Bob's oldest friends, W. J. Erich, W6AL, of Lodi, California. That week-end was the first time that Bill and Bob had met in the flesh, but their friendship is a matter of considerable standing, per medium of the ham bands, and it was remarkable how many of those present had also worked Bill at one time or another.

W. J. Erich

Bill is one of radio's old-timers. Please do not infer from this that he has one foot in the grave. Far from it. His obvious enjoyment of Bob's ZL hospitality would soon dispel any ideas of that kind. At the same time, a man who was a ship's radio officer before the present chronicler was born, and who has personal reminiscences to relate of men such as *the* Cunningham who was one of America's first valve makers, and who invented the valve base, can hardly be said to have come down in the last shower. At the present time, Bill is engaged in cattle-ranching, with ham radio as his main sideline. He and his wife were in New Zealand in the course of a holiday tour of this country and Australia, and in many parts of both countries, over-the-air friendships were being cemented by personal contact. Needless to say, there was only one topic of conversation during the evening—ham radio. Ralph Slade regaled the company with tales of those early contacts between America and New Zealand, when he and a very few other New Zealand hams did their share of real pioneering work, and Bob Black and the guest of honour himself, produced some stories that were worthy of the occasion, but which may not be reproduced here!

Altogether, it was a delightful evening for all concerned, and we do not think it was only Bob's hospitality which made us reflect that if the spirit of ham radio could only be extended to other fields where international co-operation is not quite so successful, then those problems that plague civilization today might well be much nearer to a solution.

The following hams, and others, were present:

Bill Erich, W6AL; Bob Black, ZL2BX; Fred Andrews, ZL2IJ, Civil Aviation; Ian Rowe, ZL2RU; Ron Coakley, ZL2RC, Radio Div. P. & T. Department; K. McEwen, ZL2WS; Max Farrell, ZL3HZ (operates as Portable ZL2;; Harry Bradbury, Fears, Ltd.; Herb. Cassey, ZL2HC, P. & T. Department; Ralph Slade, ZL2BK, formerly ZL4AG; Bob Carr, ZL2DL; Fred Cropley, ZL2AAH; Bill Porter, a staunch friend of Bob Black's; Doug. Foster and Alex Ayton, *Radio and Electronics.*

Sam Heginbotham, formerly chief radio inspector of the P. & T. Department, was unavoidablly absent.

The "RADIO and ELECTRONICS" Abstract Service

AERIALS AND TRANSMISSION LINES

A mobile antenna for the low-frequency bands (75 metres and thereabouts) can be improved by "capacity hats." The "hat" consists of a ring or metal spider located around the antenna whip above the loading coil unit. Feed considerations are discussed.

—*QST* (U.S.A.), January, 1952, p. 52.

U.H.F. receiving antennae. Five types are shown here in summary which have outstanding performance and low cost. The fan dipole is the simplest and requires only two triangles of metal; also the corner reflector which gives ultimate gain for its size; also rhomboids, stacked V, and Yagi. Field patterns are given.

—*Electronics* (U.S.A.), January, 1952, p. 132.

AUDIO EQUIPMENT AND DESIGN

A loudspeaker without diaphragm actuated by the direct modulation of ionized air. The principle was first used by Duddell in his singing arc. The idea is to use a powerful source of positive ions from a chemical composition containing precipitated platinum which used as an anode can produce high ionization of air. The device may be the harbinger of a new era for the loudspeaker.

—*Wireless World* (Eng.), January, 1952, p. 2.

CIRCUITS AND CIRCUIT ELEMENTS

The amplification process moves nearer to perfection with the single ended push-pull amplifier. This amplifier was worked out by McIntosh and Gow and uses in the input a bifiliary wound primary transformer, and a circuit that overcomes the probability of capacitance between windings. This gives extremely high capacity coefficients with the possibility of doing away with the output transformer and coupling the loudspeaker directly.

—*Proceedings of the I.R.E.* (U.S.A.), January, 1952, p. 7.

Magnetic centring of electrostatic C.R. tubes. The centring can be by three different devices, the rotatable magnet, the contra-rotatable magnet, or the offset ring. A summation of the types given.

—*Electronics* (U.S.A.), January, 1952, p. 10.

ELECTRONIC DEVICES

The stroboscopic earth inductor compass consists of the indicator, high gain voltage amplifier, and a stroboscope. The voltage output of a rotating coil is a pure sine wave due to the earth's field and its phasing is dependent on the direction of the field. The synchronized stroboscope light gives the direction.

—*Electrical Engineering* (U.S.A.), November, 1951, p. 1001.

Tomato classification by spectrophotometry. When tomatoes are delivered for canning there may be disagreement as to the grading, and to eliminate the human element, a bridge spectrophometer measures the ratio of reflected light at two critical points.

—*Electronics* (U.S.A.), January, 1952, p. 92.

The establishment of a correlation between natural phenomena, especially in astronomy is frequently most important. The apparatus consists of a frequency standard that generates a frequency standard voltage, a phase shifter to provide a means of connecting clocks, a power amplifier to drive them, and a monitoring method for indicating time discrepancies.

—*Ibid*, p. 99.

Nuclear researches have made necessary the precise measurements and stabilization of electric fields. The technique makes possible the regulation of a 35-ton magnet with high accuracy. Measurements of absolute field are obtained with an oscilloscope and a frequency meter.

—*Ibid*, p. 114.

The distributed-line amplification principle can be successfully employed for the amplification of short pulses of 10 millimicroseconds using conventional tubes. The tubes are coupled in two banks and the distortion is very low for such short time duration as the system requires.

—*Ibid*, p. 113.

Servo-mechanisms; the article gives a simple approach from first principles with a study of the control required and the vexed problem of "hunting" or oscillation. The velocity feedback method which has an analogy in the negative feedback of an amplifier, is also described.

—*Wireless Engineer* (Eng.), January, 1952, p. 25.

MATERIALS, VALVES, AND SUBSIDIARY TECHNIQUES

A new design of tube uses both density control and deflection control. The grid controls the space charge and gives also a displacement of the beam. This new principle demonstrates the possibility of an increase in transconductance and the transconductance-to-plate current ratio of the tube.

—*Proceedings of the I.R.E.* (U.S.A.), January, 1952, p. 41.

Magnetron oscillators may be constructed on a miniature scale to serve as efficient local oscillators. A tube of conventional appearance is ringed with a magnet. By operating as a negative oscillator it is possible to generate frequencies of a few cycles per second. An inexpensive type tube can, therefore, cover a range from 0-1000 mc/sec. with output of half a watt or less.

—*Electronics* (U.S.A.), January, 1952, p. 104.

The manufacture of germanium. The fact is stated that the element can now be obtained from gas producer flues and British manufacturers have an assured home supply and much is being done towards securing absolute purity. Rectifying barriers can now be obtained inside the metal, doing away with the cat's-whisker. The processing of n-p-n sections is also mentioned.

—*Wireless Engineer* (Eng.), January, 1952, p. 29.

MEASURING INSTRUMENTS AND TEST GEAR

A single-band audio generator; the device is a simple resistance tuned oscillator capable of covering the audio frequency range with the variation of a single resistor. The device has three tubes and gives a choice of two outputs, five volts and thirty volts. A vector analysis of the circuit is given.

—*Electronics* (U.S.A.), January, 1952, p. 95.

PROPAGATION

The "Rothmann Modulation System" has a new look about it. The original idea was conceived by Max Rothmann and can be used with any tetrode amplifier regardless of the power. It is a version of the clamp tube modulation and is a very simple form of controlled carrier modulation.

—*QST* (U.S.A.), January, 1952, p. 56.

There frequently form within the normal "E" layer of the ionoscope "patches" of abnormally close ionization capable of reflecting waves of high frequency. The patches are of random character but it does seem possible to trace the growth and movement of the sporadic E clouds from measurements made at a number of stations which are studying the phenomena.

—*Wireless World* (Eng.), January, 1952, p. 5.

After a long period of rumour, facts are emerging regarding V.H.F. broadcasting for England. The frequency range will probably be 88-100 mc/sec. The modulation system is still being argued about, but it is intended to give a three-programme service to 87 per cent. of the population of Great Britain.

—*Ibid*, p. 10.

RECEIVERS

Those who read of the germanium triode receiver will be pleased to have more details. The output power of a single unit is about 20 milliwatts, and the amplification of each stage is 20-30 db. The smallness and compactness of the design is most impressive.

—*N.Z. Electrical Journal*, December, 1951, p. 1045.

It was believed impossible to design receivers for the 420 mc/sec. range without lighthouse or other special tubes, but here is a design using a 6J4, 6J6, or 6AB4. The plumbing is not too difficult and here is an interesting field of research which might otherwise not be possible without expense.

—*QST* (U.S.A.), January, 1952, p. 28.

TELEVISION

With different television standards in various areas of the world converting from one set of standards to another is a problem needing solution. A discussion on programme interchange between 525, 60 frames, and 626, 50 frames interlaced. Photographic recording and electric storage methods are employed.

—*Electronics* (U.S.A.), January 1952, p. 86.

MISCELLANEOUS

Students have difficulty in understanding the working of alternators in parallel especially if not adept with the operator "j." The study is made easy with a few vector diagrams and analogies.

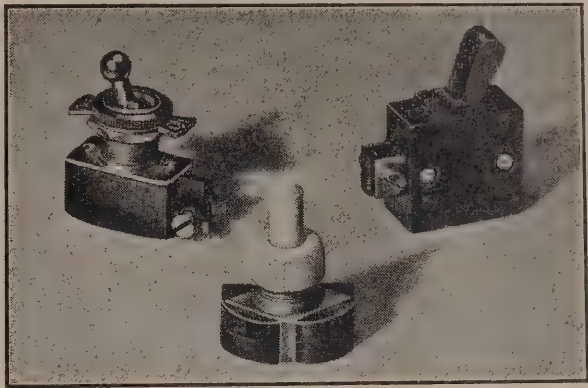
—*N.Z. Electrical Journal*, December, 1951, p. 1027.

New uses for surplus disc rectifiers. By arranging these correctly there is a variety of uses they can be put to for rectifying A.C. Ingenious methods are given for coupling the rectifiers to deal with different ratings.

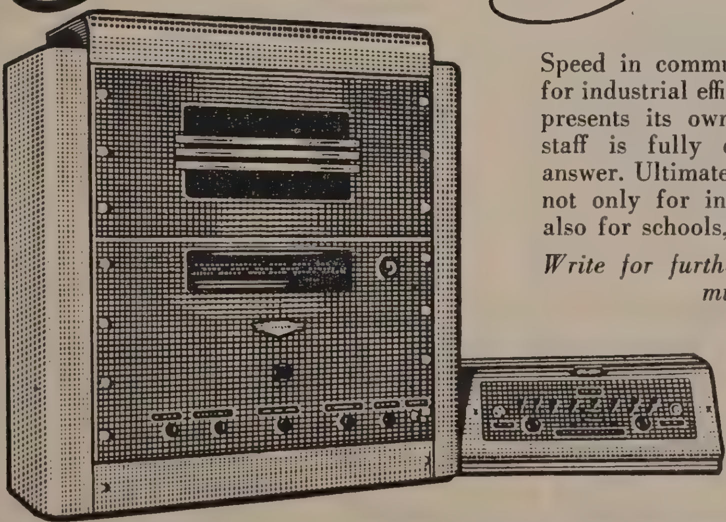
—*QST* (U.S.A.), January, 1952, p. 31.

Energy—not something theoretical, but the real stuff of electricity— mention is made of energy in its various guises, mass and energy, gas and storage in the electric field. This is a valuable article for the student.

—*Wireless Engineer* (Eng.), January, 1952, p. 33.



S.600 S.308 S.720



Latest Releases of L/P Records in New Zealand

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LA.8530—Souvenir Album, Dick Haymes.
LA.8531—Just Jazz, The All Stars.
LA.8532—Valentino, The Castilians.
LA.8534—Louis Armstrong Album, Louis Armstrong.
LA.8535—Square Dances, MacLeod's Dance Band.
LAT.8014—Rhapsody in Blue; An American in Paris, Camarata and Orchestra.
LAT.8015—Soliloquies from "Hamlet." John Gielgud.
LF.1016—Musical Comedy Favourites, Stanley Black & Orchestra.
LF.1031—Chopin Preludes and Mazurkas, Ronnie Munroe & Orch.
LF.1049—Tyrolean Melodies, Franz Winkler Trio.
LF.1050—Samba with Ros, Edmundo Ros & His Orchestra.
LF.1051—Latin American Rhythm, Edmundo Ros & His Orch.
LF.1052—Music of Vincent Youmans, Robert Farnon and His Orchestra.
LF.1053—Anton Karas (Zither Solos), Anton Karas.
LF.1054—Zulu Music and Songs.
LF.1055—Tropical Magic, Stanley Black & Orchestra.
LF.1056—Gerry Schomann Vocals, Gerry Schomann.
LF.1057—Melodic Gems, Harry Davidson & Orchestra.
LF.1059—Orchestral Selection, Harry Fryer and His Orchestra.
LF.1060—Listen to My Music, Ted Heath & His Orchestra.
LF.1061—Charlie Kunz Selection, Charlie Kunz.
LM.4542—Sonata No. 1 in G Minor for Violin (Bach), Osy Renardy.
LM.4543—Michael Morley (Boy Soprano), Michael Morley.
LM.4544—Songs Without Words—Scenes of Childhood, Op. 15, Albert Ferber (piano).
LM.4545—Margaretta Kjellberg (vocals), Margaretta Kjellberg.
LK.4040—The Ghost Train, Claude Hulbert & Cast.
LK.4041—Julius Caesar (Shakespeare), Griffith Jones & Cast.
LK.4042—A Tale of Two Cities (Dickens), Griffith Jones & Cast.
LK.4043—Kathleen Long Plays Ravel and Chabrier.
LK.4044/5—Iolanthe, D'Oyle Carte Opera Co.
LK.4046—Pictures at an Exhibition (Mussoresky), Julius Katchen (piano).
LK.4047/8—Patience, D'Oyley Carte Opera Co.
LX.3037—A Recital by Mado Robin, Mado Robin.
LX.3055—Concerto Grossi in E Major, Op. 6, Nos. 5 and 6 (Handel), Boyd Neel Orchestra.
LX.3059—Symphony No. 3 In D Major and Fantasy in C Major, Op. 15 (Schubert), Clifford Curzon.
LX.3060—Mass for Five Voices (Byrd), The Fleet Street Choir.
LX.3061—Serenade in G Major, K.535, and Divertimento in D Major, K.136 (Mozart), The Stuttgart Chamber Orchestra.
LX.3062—Sonata in B Minor (Liszt), Nikita Magaloff (piano).
LX.3063—Famous Overtures, No. 2, London Symphony Orchestra.
LX.3064—Concerto No. 2 in G Minor for Piano and Orchestra (Saint-Saens), Moura Lympany and London Phil. Orch.
LX.3065—Christmas Eve in Vienna, Chorus & Orchestra of Vienna State Opera.
LXT.2589—Famous Overtures, No. 1 (Suppe), London Philharmonic Orchestra.
LXT.2590—Famous Overtures, No. 3 (Offenbach), London Philharmonic Orchestra.
LXT.2600—Four Concerti from Op. 8 (Vivaldi), Stuttgart Chamber Orchestra.
LXT.2601—String Quartet, No. 3 in E Flat Major (Dvorak), The Boskovsky Quartet.
LXT.2602—Symphony No. 1 in B Flat Major, Op. 38 (Schuman), L'Orchestre de la Suisse Romande.
LXT.2603—Sonata No. 6 in F Major, Op. 10, No. 2; Sonata No. 25 in G Major, Op. 79; Sonata No. 5 in C Minor, Op. 10, No. 1 (Beethoven), Wilhelm Backhaus.
LXT.2604—Sinfonia For Double Orchestra in E Flat Major, Op. 18 (Bach); Symphony No. 3 in D Major (Schubert), Cincinnati Symphony Orchestra.
LXT.2605—Nuits D'Ete O Song Cycle, Op. 7 (Berlioz), Suzanne Danco.
LXT.2606—Famous Overtures, No. 4, London Philharmonic Orchestra.
LXT.2607—The Merry Widow, Tonehalle Orchestra & Chorus.
LXT.2608—Symphony No. 5 in E Minor, Op 95 (Dvorak), New Symphony Orchestra.
LXT.2609—Overtures to the Gilbert and Sullivan Operas, New Symphony Orchestra.
LXT.2610—Caucasian Sketches, Op. 10—The Sleeping Princess, L'Orchestre du Conservatoire de Paris.
LXT.2611—The Nutcracker Suite, L'Orchestre du Conservatoire de Paris.
LXT.2612/3—The Gypsy Baron (Strauss), State Opera Chorus and the Vienna Philharmonic Orchestra.
LXT.2614—Symphony No. 34 in C Major, K. 338; Symphony No. 38 in D Major, K. 504 (Mozart), L'Orchestre de la Suisse Romande.
LXT.2615/7—Carmen (Bizet), Orch. & Chorus of the Opera Comique Paris.
LXT.2618/20—Manon (Massenet), Orch. & Chorus of the Opera Comique Paris.
LXT.2621—Nights in the Gardens of Spain; Three-cornered Hat, Clifford Curzon—New Symphony London Symphony Orch.
LXT.2622/3—La Boheme, Renata Tebaldi, Hilde Gueden, etc.
LXT.2624—Sonata in B Flat, Op. 106 (Beethoven), Friedrich Gulda.
LXT.2625—French Overtures, Orch. of the Opera Comique Paris.
LXT.2626—Piano Quintet (Bloch) Quintetto Chigiano.
LXT.2627—Concerto No. 1 in C Major (Beethoven), Friedrich Gulda & Vienna Phil. Orchestra.
LXT.2628—Grand Sextet in E Flat, Op. 62 (Kreutzer), The Vienna Octet.
LXT.2629—Concerto No. 4 in G Major (Beethoven) Wilhelm Backhaus & Vienna Phil. Orchestra.
LXT.2630—Midsummer Vigil—Swedish Rhapsody (Alfven); Siguard Jorsalfar (Grieg), Cincinnati Symphony Orchestra.
LXT2631—Petite Symphonie Concertante (Frank Martin); Divertimento Le Baiser de la Fee (Stravinsky), L'Orchestre de la Suisse Romande.
LXT.2631—La Mer (Debussy); Mare L'Oyle (Mother Goose) (Ravel), L'Orchestre de la Suisse Romande.
LXT.2633—Overtures by Weber, Vienna Phil. Orchestra.
LXT.2634—Music of Johann Strauss, No. 2, Vienna Phil. Orch.
LXT.2635—Arias from "Die Entfuhrung Aus Dem Serail," Wilma Lipp, etc., & Vienna Phil. Orchestra.
LXT.2638/40—Madame Butterfly (Puccini), Orch. & Chorus of the Accademia Di Santa Cecilia Rome.
LXT.2641—Symphony No. 4 in G Major, Op. 88 (Dvorak), Concert Geboun Orchestra of Amsterdam.
LXT.2642—Symphony Fantastique, Op. 14 (Berlioz), Concertgeboun of Amsterdam.
LXT.2643—Symphonia Domestic, Op. 53, The Vienna Phil. Orch.
LXT.2644—Scenes from Wagnerian Music Dramas, The Vienna Phil. Orch.
LXT.2645—Vienna Philharmonic's "New Year" Concert.
LXT.2646/7—The Mastersingers of Nuremburgh, Act 1, Vienna State Opera Chorus & Orchestra.
LXT.2648/50—The Mastersingers of Nuremburgh, Act 3, Vienna State Opera Chorus & Orchestra.
LXT.2651/6—Parsifal (Wagner). Bayreuth Festival Choir.
LXT.2657—Concerto in A Minor (Grieg), Curzon & London Symphony Orchestra.
LXT.2658—Toccata for Piano, Op. 29—Sonata for Flute and Piano, Walter Frey.
LXT.2659/64—The Mastersingers of Nuremburgh (Wagner), Vienna State Opera Chorus and Orchestra. (Complete recording.)
LXT.2665—Symphony No. 1 in C Sharp Minor (Rangstroem), Stockholm Concert Orchestra.

STOLEN RADIOS

The following reports have been received by the New Zealand Radio Traders' Federation, and should any member of the Federation or any reader have knowledge of the present whereabouts of any of this radio equipment, he is asked to communicate with the nearest police station.

Criminal Investigation Branch, Wellington

Stolen from the Porirua Mental Hospital between 26th December, 1951, and 2nd January, 1952: Philips, brown bakelite case; 5-valve; two tuning control knobs. Serial No. 32811.

Criminal Investigation Branch, Auckland

The undermentioned radio, the property of Mick Aoake, c/o 183 Landscape Road, Mt. Eden, Auckland, was stolen from the Mission Bay Reserve, Auckland, between 8 p.m. and 9 p.m. on 24th February, 1952: One Ultimate portable radio, battery and electric A.C. and D.C.; wood case with imitation crocodile paint finish; 15 in. x 11 in. in size; white plastic handle, white plastic band encircling dial, three white knobs, three white plastic bands running across dial; Ultimate in white plastic letters on right-hand corner. Valued at £35. Number not known and cannot be ascertained.

The undermentioned radio, the property of Frank Ambrose Harker, 107 Brighton Road, Parnell, was stolen from the complainant's motor-car while parked outside the above address between 6 p.m. on 18th March, 1952, and 7.30 a.m. on 19th March, 1952: One car radio bearing Cambridge trade name on a plate which has had the corners cut off for the set to sit in the dashboard, grey metal body measuring 7 in. x 6 in. x 11 in.; two white control knobs; wiring chart has been glued on to the inside of the chassis by tape; several peculiarities in the wiring; the speaker is a Rola make, with the transformer fitted on the body by means of two screws; the whole is in a brown metal case with a coarse cloth cover over the speaker plate. The above set was made by the complainant and does not have a number, but is identifiable by general appearance.

The undermentioned property was stolen from a parked car in Lorne Street, Auckland, between 8 p.m. and 10.30 p.m. on 19th March, 1952. The radio is the property of Mrs. Maureen Opal Montague, 126 Point Chevalier Road, Auckland: One Arnrite portable radio, pale green plastic case, white handle; case about 8 in. x 5 in. x 5 in.; 4-valve, minus batteries and other components, not in working order; owner has experienced trouble in having this radio repaired; has two small cigarette burns near plastic handle; valued at £12; identifiable by general appearances; number not known and cannot be ascertained.

Criminal Investigation Branch, Rotorua

Stolen at Rotorua between 8th and 10th March, 1952: Car radio, Ford, made by Autocrat Co.; 6-valve, 12-volt; brown dial, two white knobs, square brown metal speaker; serial number of radio is 2785 and may be on a metal plate on radio.

Police Station, Petone

Stolen from the railway signal box at Petone railway station yards between 12.45 a.m. and 10.05 p.m. on 23rd March, 1952: Six-valve dual wave Radion wireless set, old model in a dark oak veneer cabinet 2 ft. high, about 15 in. wide, and 1 ft. deep; cabinet is slightly narrower at top, round dial about 6 in. in diameter; top half of dial marked for broadcast, believed in metres from 5; four tuning knobs in front; serial number not known; valued at £10; identifiable by general appearance; set originally purchased from W. Masters, late radio salesman, of Petone.

Criminal Investigation Branch, Wellington

Stolen in Wellington on 8th February, 1952: Mullard battery electric portable in light brown leatherette, with cream bakelite front and back; model No. 681; licence No. 32172; serial No. 26318.

Stolen in Wellington between 29th December, 1951, and 19th January, 1952: Arnrite portable battery, cream plastic case; "From Freda to Myrtle, 1949," engraved in red lettering on top of cabinet.

Criminal Investigation Branch, Auckland

Stolen in Auckland on 14th February, 1952: One 5-valve dual-wave Philco make mantel model radio, mahogany coloured plastic case, size about 20 in. x 16 in. x 10 in.; back of set is completely closed in; model 818; sloping oblong-shaped dial along top of front with longitudinal lines for various wavelengths; four control knobs, new condition, cream plastic cord with three-pin plug attached; serial No. 19776.

Police Station, Waihi

Stolen from Waihi Beach on 31st December, 1951: Philco portable radio, dual power set, model 353; back and sides of brown leatherette, front and top light-coloured wood; sliding cover over dial and controls, handle fitted to top has a broken spring pro-

(Continued on Page 48.)

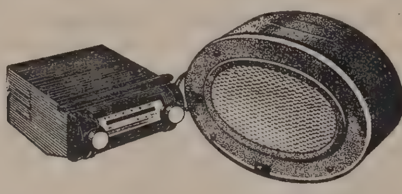
NEW PRODUCTS: LATEST RELEASES IN ELECTRICAL AND ELECTRONIC EQUIPMENT

This section of our paper is reserved for the introduction of new products and space preference is given to our regular advertisers. Advertising rates are charged according to space occupied. For further particulars contact Advertising Manager, R. and E., Box 8022, Wellington.

THE "ULTIMATE" CAR RADIO

The new "Ultimate" two-unit car radio, which is now finding great favour with purchasers of car sets, is shown here, and can be best described as a very high-quality receiver having outstanding sensitivity and selectivity plus a true rich tone.

The "Ultimate" car radio is a brand-new model, employing a 6-9 elliptical speaker mounted in a pressed housing having excellent acoustic properties.



The response from the speaker is the equivalent of an 8 in. circular reproducer.

The "Ultimate" auto radio has been designed especially to give the listener good performance in any part of the country, and special attention has been given to the elimination of extraneous mechanical noises and ignition interference.

The "Ultimate" auto radio is available in either 6-volt or 12-volt models, and the tuning unit is small enough to fit easily under the dashboard of the smallest modern car. The speaker unit is protected by a grille of expanded metal, and included on this unit is a two-position tone switch.

The "Ultimate" auto radio retails at £38 10s. 6d.

Specifications:

Frequency range: 550-1500 kc/s.

Drain: 6-volt model, 5.5 amps.; 12-volt model, 3 amps.

Speaker: Rola 6-9H P.M.

* * *

PHILIPS EQUIVALENT FOR 813

Philips have again extended their increasingly valuable list of American equivalents by making available the QB2/250 which is a direct equivalent of the popular U.S.A. type 813.

Good supplies are now available from Philips at the surprisingly low price of £6 10s. plus 20 per cent. tax (which includes postage throughout New Zealand).

PHILIPS 1163 AND 1164 RECTIFIERS

Owners and users of battery chargers throughout New Zealand well remember the long life of the original American Tungar tubes and their ability to stand up to hard usage.

During recent years they have been very hard to come by and many users have been forced to employ inferior substitutes.

It is therefore all the more pleasing to report that Philips Type 1163 6 amp. and Type 1164 15 amp. rectifying tubes have proved to be such excellent substitutes for the Tungar types during the last twelve months.

Phiilps Type 1163 six amp. tube is a sturdy, argon-filled rectifier whose very low losses are independent of tube loading.

Its already excellent characteristics have now been further improved by an increase of the peak inverse rating to 375 volts.

The 1163 can replace the following American types with every satisfaction to the user: 189048, 189049, 178148, 178149, 289414, 289416, CE225, CE226, G48, G49, and all RMA types 4B26.

Type 1164 is the Philips 15 amp. Tungar equivalent and can replace the American types 217283, 180238, 766776, CE235 and G83.

When putting any new rectifying tube of this type into use, the following helpful hints should be noted:

Preheat the filament (i.e., with anode voltage disconnected) for 15 seconds before applying anode load for the first time.

Never disconnect the heater voltage before the anode supply voltage.

When designing a transformer for such a tube, take care to ensure that the secondary voltage decreases about 5 to 7 per cent. on full load.

Make sure that the distance between tubes (when more than one are used) is at least ¾ tube diameter and that they are at least ½ tube diameter from any enclosure or other components.

See that the tube maintains good contact with the holder and that the anode connection is kept clean.

Good stocks of these 6 amp. and 15 amp. Tungar equivalents are now held by Philips branches throughout New Zealand. They may also be obtained from Messrs. Turnbull & Jones, Ltd., John Chambers & Son, Ltd., Hope Gibbons Ltd., Cinema Supplies, Ltd., L. M. Silver, Ltd., Gaumont-Kalee, Ltd., Scammell & Eglinton, Ltd., Toomeys Grinding & Gear Co., Ltd., Watson, Steele & Ganley, Standard Importing Co., Thomas Ballingers Ltd., J. J. Niven, Ltd.

H.M.V. "HAMPTON" 7-VALVE RADIOGRAM CONSOLE, MODEL 517 ORG

Here is another His Master's Voice true-to-life radio achievement in the field of radiogram consoles.

Designed and built by the H.M.V. world-wide organization, this model is a leader in the world of performance. Featured in the cabinet of highly-figured walnut veneer is a 7-valve dual-wave radio and the latest three-speed automatic record-changing equipment. Each unit is designed to give the correct balance of tone, which is faithfully reproduced by a 12-inch speaker.

Specifications:

Cabinet height, 29 in.; width, 35½ in.; depth, 17¾in.
Valve complement:

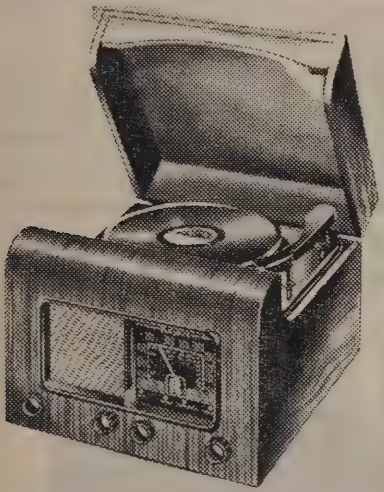
(1) KTW63, R.F. amplifier.
(2) X61M, first detector oscillator.
(3) KTW63, I.F. amplifier.
(4) DH63, second detector A.V.C.
(5) KT63, output valve.
(6) 5X4, rectifier.
(7) Y61, tuning indicator.

Frequency range: (a) Broadcast, 550-1600 kc/s.; (b) shortwave, 6-18.

Power supply: 230 volts A.C., 70 watts.

"PACIFIC" AND "REGENT" MODEL 4G2 RADIO GRAMOPHONE MANTEL MODEL

This elegant radio gramophone, which incorporates the new three-speed record player for standard, long-playing, or 45 r.p.m. records, is one of the latest models from G. A. Wooller & Co., Ltd.



Produced at the Waihi factory of Akrad Radio Corporation, the 4G2 is a 4-valve A.C. operated mantel radiogram using a three-speed record player and dual-purpose valves to obtain 5-valve radio set performance.

For general good looks and superlative performance, the 4G2 is hard to beat. High-quality walnut veneers are used in the construction of the cabinet and are finished to a high gloss; the whole unit is compact and easily transported, the dimensions being: Height, 10 in.; width, 14 in.; and depth, 16 in.

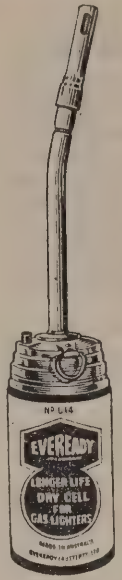
The pick-up is of the crystal type and is fitted with an ingenious arrangement whereby the whole cartridge is reversed by the flick of a key knob to expose either the stylus designed for 78 r.p.m. records or that for 33⅓ r.p.m. and 45 r.p.m.

The receiver, which has a frequency range of from 1500 to 550 kc/s., is fitted with four controls which, reading from left to right, are as follows: (a) Tone control and on/off switch, (b) volume control, (c) gramophone-local-distance switch, (d) tuning control.

All the valves are English types; the speaker uses a heavy magnet to give high sensitivity and adequate baffling is provided so that the tone is really good.

All vulnerable components have been rendered impervious to the effects of high temperature and humidity conditions. Coils and transformers are vacuum impregnated with microwax and metal work is cadmium plated so that corrosion cannot take place.

The "Pacific" and "Regent" Model 4G2 is distributed throughout New Zealand by G. A Wooller & Co, Ltd., P.O. Box 2167, Auckland.



EVEREADY NEW GASLIGHTER

The National Carbon Co., Ltd., will shortly release the new "EVEREADY" T/o 2247 Gas Lighter of English manufacture. Special features are the two stem battery housing made of heavy brass highly chromium plated and fitted with a ring hanger. The button for the press button switch is of moulded plastic, and in the burner the replaceable tip has a spring-loaded contact. The battery used is EVEREADY Type U14. Shipments are now arriving, and the retail price will be 15s. 5d. complete.

"R. & E." TECHNICAL PHOTOGRAPHS

Copies of original designs produced in our laboratory and featured in these pages are available. Prices are: Size 6 in. x 4 in, 3s. 6d.; 8 x 6, 4s. 6d.; 10 x 8, 5s. 6d. Please remit cash with order to Radio and Electronics (N.Z.) Ltd., P.O. Box 8022, Wellington.

Trade Winds

NEW ZEALAND RADIO TRADERS' FEDERATION

The approach of the annual meeting of the New Zealand Radio Traders' Federation found the Wellington Association very active in its preparations for the big event. The question of whether the Federation should widen the scope of its activities to include washing machines, refrigerators, vacuum cleaners, and other major domestic electrical appliances has been discussed recently, as have also improvements to the "Trade-in" Handbook for its new edition and joint submissions of other associations in matters of major importance.

Unfortunately, the date of the conference coincides with that of the publication of this journal, and the conclusions, etc., of the meetings cannot therefore be published until the June issue of "Radio and Electronics." From all accounts, however, the conference promises to be one of exceptional interest.

The official delegates from the Wellington branch are Messrs. W. T. Young and D. B. Billing.

When the report of Messrs. Palmer and McDonald has been presented to the Minister of Broadcasting, it is hoped to arrange for an address to be delivered by Mr. McDonald, of the Broadcasting Service, on his impressions of television broadcasting overseas. The date of this will be announced later.

Henceforth it is intended to supply all members with a monthly circular containing matters of interest to them. It is also proposed that the executive shall meet monthly, so, in future, members should be kept well advised on current affairs.

Since the Australian Government has announced the deferment of its television project, members of the Association are naturally anxious to know the present view of the New Zealand Government. A letter has recently been sent to the Minister of Broadcasting to ascertain the policy of the present Government concerning the installation of television in New Zealand.

* * *

Mr. Kenneth Cory-Wright, son of Mr. S. Cory-Wright, Director of Cory-Wright and Salmon Ltd., has now completed his B.E.(N.Z.) degree at Canterbury College, Christchurch.

In England recently, Mr. C. W. Salmon was awarded the Barber-Greene 25 Years' Service Award Plaque, the presentation being made by Mesrs. Jack Olding and Eric Harber of Barber-Greene-Olding, Ltd. The plaque itself was made by the centuries old process of combining bronze and fire-hardened stained glass.

* * *

Jim McGregor (H.M.V. (N.Z.) Ltd.) has recently completed flying trips to Auckland and Christchurch, in company with Mr. F. S. Durman of the Dayman Cycle Co., Ltd., England. According to Jim, this was as much a cycle tour as anything, Mr. Durman being amazed at the command of the right of road exercised by the

Christchurch cyclists. It seems they stop only for the express trains passing through the city!

Later, to enjoy a little relaxation and some good fishing, Mr. Durman visited Rotorua, this time accompanied by Mr. Jack Wyness.

* * *

Electro-Technical Industries, Ltd., have been appointed Wellington distributors for the Wayfarer Auto sets.

* * *

Ivan Cosgrave has rejoined the National Electrical and Engineering Co., Ltd., and will be responsible for appliance sales at the company's Wellington office. John Goodwin, also of Wellington office, is to be responsible for Neeco range sales under a re-allocation of duties.

* * *

Mr. Cingolani, president of "Radio Minerva," Milan, recently visited the Pye factory at Cambridge, England, to sign an agreement for the manufacture of Pye television receivers under licence in Italy. Television transmissions are now beginning in Turin, and studios are planned for Milan and Rome.

* * *

The fourth edition of "Radiotron Designers' Handbook' is expected to be published in Australia about May or June, and should be available in New Zealand very soon thereafter.

This new edition is a complete rearrangement of the whole work, which has been rewritten to suit the needs of today. Being nearly four times the size of the third edition, its contents are naturally much more detailed, and should prove invaluable. Sales of the third edition exceeded 280,000 copies and extended into several translations, including Polish.

National Carbon Pty. Ltd. announces the impending release of some very interesting new types of sales promotion pieces which should prove invaluable to dealers—so watch out for the next visit of that Eveready traveller!

* * *

The passing of Francis Edward Duggan, which took place on 26th March, will be received with regret by his many old associates in the radio industry. Frank, as he was popularly known, had that friendly and helpful manner which endeared him to all. Although for the past eight or nine years he had severed his active connection with the business side of radio, his passing has revived memories of the early days of radio in New Zealand.

Joining the staff of Amalgamated Wireless, Australasia, Ltd. in 1914, he served throughout World War I in troopships and cargo ships, afterwards being appointed chief radio officer in ships of the "Bay" line on the London-Australia run. Later he became chief radio officer of the R.M.S. "Tahiti," in the Sydney-Wellington-San Francisco service. About 30 years ago, he was appointed sea-going inspector on the Union Company's "Wahine" and "Maori," and in 1928 became shore marine inspector and assistant to the New Zealand manager of A.W.A. In 1936, he entered into partnership with Mr. Allan Webster in a radio business, departing from Wellington in 1943 to take up farming near Otaki.

We extend our sympathy to his widow and only son, Travers.

(Continued on Page 48.)

Proceedings of the New Zealand Electronics Institute Incorporated.

HEADQUARTERS NEWS

Rutherford Memorial Appeal

A further meeting of the Rutherford Memorial Appeal Committee was held toward the end of March. It was reported that donations in the Wellington area had now reached £1,860, and the New Zealand total was now more than £8,000, hence there seems to be a good chance of reaching £10,000. Sir John Cockcroft would be visiting Wellington during September 15th to 19th and his total time in New Zealand would be 23 days. Future action to decide means of obtaining the balance of money required was discussed and agreed upon.

General Secretary's Visit to South Island

The General Secretary recently visited South Island Centres and from reports received it would seem that activities have commenced for the session. Arrangements are in train to hold the next meeting of the Executive in Dunedin during the early part of May and it is hoped to have the full report of the meeting available for the next proceedings.

Christchurch Branch

The first meeting of 1952 was held in the Electrical Lecture Room, Canterbury University College at 7.30 p.m. on Monday, March 31st, when Mr. B. T. Withers spoke on "Modern Trends in Television Receiver Design." A nine-inch English G.E. TV receiver, the property of Mr. P. C. Collier was on view for members to inspect. The meeting was well attended and enjoyed by all those privileged to be present. The thanks of the Christchurch Branch are due to Mr. P. C. Collier for kindly loaning them the TV equipment referred to above.

Dunedin Branch

Activities in Dunedin will recommence very shortly and reports regarding functions held should be available in the next issue of the proceedings.

TRADE WINDS

(Continued from page 45.)

The various branches of Swan Electric Co., Ltd., were represented at a Sales Staff Conference held in Wellington in April. Mr. Wm. J. Blackwell presided.

* * *

A recent visitor to New Zealand was Mr. H. T. Parker, Board's representative of the Plessey group of companies, England. Mr. Parker, who has recently suffered a very severe illness, is visiting these regions for both business and convalescence purposes and has made a rapid visit to the main centres, calling upon the many manufacturers who have for so long been using Plessey products. Throughout his visit, Mr. Parker was accompanied by representatives of the Plessey sole New Zealand agents, Swan Electric Co., Ltd., who were able to learn at first hand Plessey's recently revised marketing policy for their smaller and more distant export markets.

* * *

TV provides a great source of entertainment for the officers and men of the Royal Navy, for a Pye TV receiver was recently installed in the wardroom of H.M.S. "Dodman Point. Receivers have also been installed in the crew's quarters of two other ships of the Reserve Fleet—H.M.S. "Phoebe" and H.M.S. "Cavendish."

"Considering the amount of electrical interference and also the fringe-area conditions," said Senior-Commissioned-Electrical-Officer G. S. Swain, "reception has been of a high standard."

* * *

Our congratulations go to Mr. S. C. Brown on his recent appointment as the new managing-director of the British General Electric Co., Ltd., New Zealand. An Englishman by birth, Mr. Brown came to New Zealand in 1927, after training with the General Electric Company, England. He joined the Wellington branch of that organization, and has revisited the parent company for varying periods, the last time being 1949. Since his return to New Zealand, he has assumed some of the major responsibilities for the post-war conduct of his company's business, and his great executive capabilities and pleasant personality will prove him an able successor to Mr. H. E. Taylor. He graduated B.Sc. from Manchester University, is a Member of the I.E.E., and has spent some of his early training with A.E.G., Berlin.

* * *

An addition to the Wellington staff of British General Electric Co. is Mr. J. W. Ascroft, who arrived from England in November last from the G.E.C. English organization. His appointment is that of communications engineer. Graduating B.Sc. from the University of Liverpool, he served with the Technical Signals and Radar Branch of the R.A.F., after which he enjoyed considerable experience in the commercial field before joining the G.E. Co. at Coventry.

TV Film Making

(Continued from Page 5.)

stories of general conditions (social, economic, and so on) in specified countries or groups of countries. As I write, a reporter and a cameraman are leaving London for the Middle East; when they return we shall stage a series of programmes, each some 30 minutes in length, each dealing with one Middle Eastern country, and, on each occasion, with the commentator appearing "live" in the studio to talk about that country, to explain its problems by means of maps and diagrams and, above everything, by means of the film which he and his cameraman-colleague have produced.

Summarizing, there is no mystery about the production of film for television, but its appetite for film is insatiable, and production costs must be kept as low as possible in consequence. A production ratio of more than three to one is not economic for television, and I foresee that when the quality of 16 mm. sound-on-film is as high as it is now on 35 mm., television films will swing over almost entirely to the sub-standard size.

Stolen Radios

(Continued from Page 41.)

truding through the leather handpiece; small chip of paint off left-hand side and a dark mark on left-hand side; serial No. 29534.

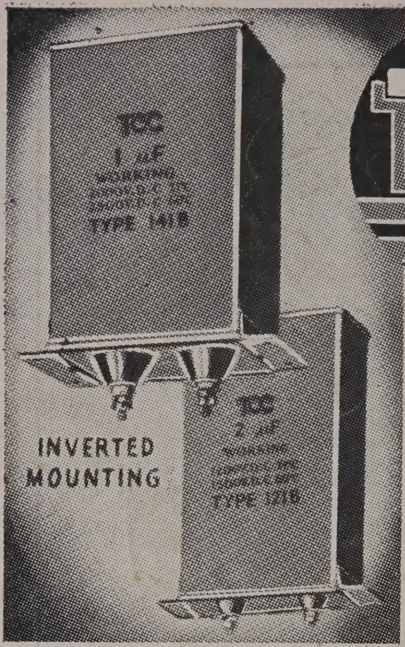
C.I.B., Palmerston North

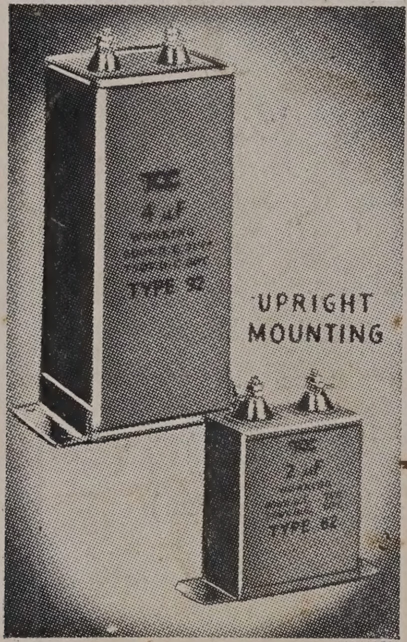
Stolen in Palmerston North between 15th and 17th February, 1952: Ultimate electric portable radio, serial No. 121725; wooden three-ply cabinet; painted imitation crocodile leather; large round dial, clear face with blue background; three operating knobs; 5 ft. white plastic flex.

RADIO RECOVERED

C.I.B., Palmerston North

The Rolls Auto car radio No. 132740 and speaker unit have been recovered.





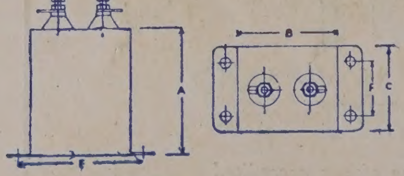
TROPICAL PAPER *Capacitors*

IN RECTANGULAR METAL CANS

TYPE	CAPACITANCE uF	DIMENSIONS IN INCHES A	B	C	E	F
TYPE 62	+0.25	2⅜	1¾	¾	2⅛	—
350v. D.C. working	+0.5	2⅜	1¾	¾	2⅛	—
(at 60 deg. C.)	+1.0	2⅜	1¾	¾	2⅛	—
	+2.0	2⅜	1¾	1	2⅛	—
	+4.0	2⅜	1¾	1¾	2⅛	—
	8.0	4.11/16	1⅝	2⅝	2	1⅞
TYPE 82	+0.25	2	2	¾	2⅜	—
500v. D.C. working	+0.5	2⅜	2	¾	2⅜	—
(at 60 deg. C.)	+1.0	2⅜	2	¾	2⅜	—
	2.0	2⅜	2⅛	1¼	2½	—
	4.0	2.9/16	2⅛	2⅜	2½	1⅜
	8.0	4.11/16	1⅝	3⅛	2	2⅜
TYPE 92	+0.25	2⅜	2	¾	2⅜	—
750v. D.C. working	+0.5	2⅜	2	¾	2⅜	—
(at 60 deg. C.)	+1.0	2⅜	2	1	2⅜	—
	2.0	2.9/16	2⅛	2⅛	2½	1⅜
	4.0	4.11/16	2⅛	2⅛	2½	1⅜
	8.0	4.11/16	2⅛	4⅛	2½	3⅜
TYPE 111	+0.25	2⅜	2	¾	2½	—
1,000v. D.C. working	+0.5	2⅜	2	¾	2½	—
(at 60 deg. C.)	1.0	2.9/16	2⅛	1⅜	2½	—
	2.0	4.15/16	2⅛	1⅜	2½	—
	4.0	4.15/16	4⅛	1⅜	4½	—
	8.0	4.15/16	4⅛	2⅜	4½	1⅝
TYPE 121B	+0.1	2⅜	2	¾	2½	—
1,500v. D.C. working	0.5	2.9/16	2⅝	1⅜	3	—
(at 60 deg. C.)	1.0	4.15/16	2¼	1⅛	2⅝	—
	2.0	4.15/16	3⅛	1⅜	3½	—
	4.0	4.15/16	3⅛	2⅝	3½	1⅞
	8.0	4.15/16	5⅛	3⅛	5½	2⅜
TYPE 131	0.1	2.9/16	2¼	1⅛	2⅝	—
2,000v. D.C. working	0.5	4.15/16	2¼	1⅛	2⅝	—
(at 60 deg. C.)	1.0	4.15/16	2⅝	1⅝	3	—
	2.0	4.15/16	2⅝	2⅜	3	1⅞
	4.0	4.15/16	4⅞	2⅜	5¼	1⅞
	8.0	4.15/16	4⅞	5⅛	5¼	4⅜

NOTE: If inverted mounting (through chassis) style required, add suffix "IM" when ordering.

+Denotes plain soldered seams (others rolled seams).



T.C.C. Capacitors in metal cans have a world-wide reputation for toughness and long life. Their electrical characteristics, which are the result of intensive research and development, unquestionably put them in the forefront for trouble-free tropical working. Complete hermetic sealing; careful vacuum filling and impregnation; and design that affords the lowest possible inductance, combine to permit continuous working under the most arduous conditions, including temperatures up to 71 deg. C. They are available with top or bottom brackets as illustrated. IN THE BEST SETS YOU'LL SEE T.C.C.

TURNBULL and JONES LTD.

Auckland Wellington Christchurch Dunedin
Hamilton Palmerston North Invercargill